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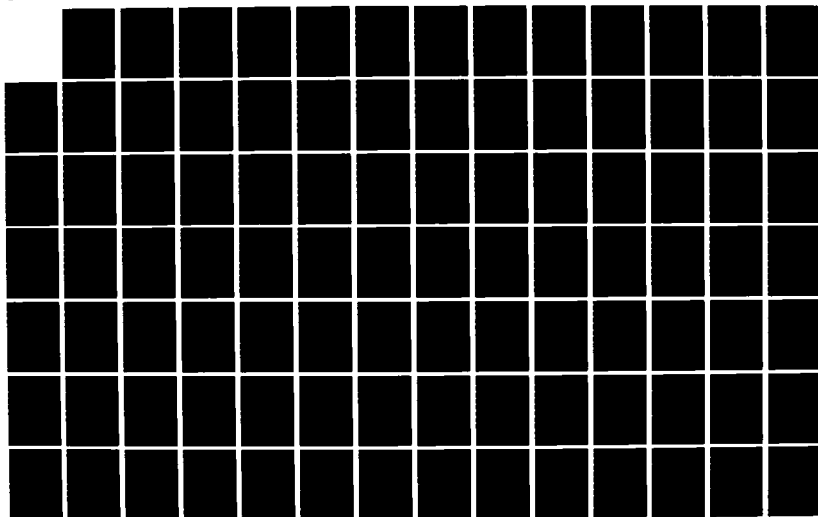
NAVY-ASEE (AMERICAN SOCIETY FOR ENGINEERING EDUCATION)
SUMMER FACULTY RES. (U) OFFICE OF NAVAL RESEARCH BOSTON
MASS R L STERNBERG 1982

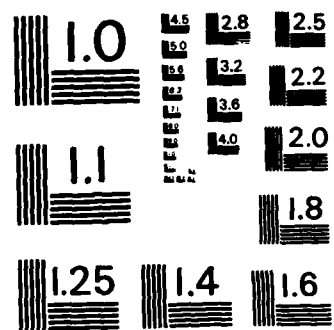
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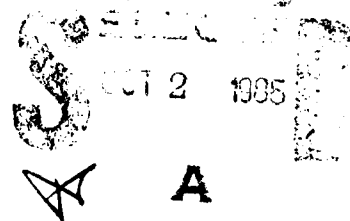
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ANNUAL REPORT
on the
NAVY-ASEE SUMMER FACULTY
RESEARCH PROGRAM
for
1982
with a
CUMULATIVE COMPILATION OF DATA ON LATER
RESEARCH FALLOUTS
from the
1979, 1980 and 1981
PROGRAMS

Robert L. Sternberg

Office of Naval Research
Detachment, Boston
495 Summer Street
Boston, Massachusetts 02210



Approved
for release

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I. INTRODUCTION AND EXECUTIVE
SUMMARY

I. INTRODUCTION AND EXECUTIVE SUMMARY

About the 1982 Program

the Office of Naval Research

Continuing and expanding the Navy Summer Faculty Research Program (NSFRP) conducted for ONR by the American Society for Engineering Education (ASEE) previously in the summers of 1979, 1980 and 1981, the NSFRP program in 1982 brought 97 faculty members from United States colleges and universities to 10 Navy laboratories for 10 weeks cooperative summer research between the NSFRP participants and scientists at the laboratories working in areas of mutual interest to both parties.

As in the earlier years the objectives of the NSFRP program in 1982 were:

- 1. To engage university faculty members in the research programs of the participating Naval laboratories;
- 2. To develop a basis for continuing research of interest to the Navy at the participating faculty members institutions;
- 3. To establish continuing relations among faculty members and their professional peers in the Navy laboratories; *in L*
- 4. To enhance the research interests and capability of the science and engineering faculty members taking part in the Navy program.

As previously the NSFRP program was conducted in 1982 by ASEE and participation was restricted to United States citizens holding teaching or research appointments in American institutions of higher education.

The 10 Navy laboratories that took part in the program during 1982 were:

Naval Research Laboratory, Washington, DC
Naval Medical Research Institute, Bethesda, Maryland
Naval Air Development Center, Warminster, Pennsylvania
Naval Coastal Systems Center, Panama City, Florida
Naval Ocean Systems Center, San Diego, California
Naval Personnel Research and Development Center,
San Diego, California

Naval Ship Research and Development Center
Annapolis and Carderock, Maryland

Naval Surface Weapons Center, Silver Spring, Maryland
and Dahlgren, Virginia

Naval Underwater Systems Center, Newport, Rhode Island
and New London, Connecticut

Naval Weapons Center, China Lake, California

The 97 faculty member participants taking part in the 1982 program were selected by the Navy laboratories from 495 applicants and came from colleges and universities in all parts of the United States. Included in this representation were 45 of the contiguous states, the District of Columbia, Hawaii and Puerto Rico.

Disciplines covered in the research conducted under the NSFRP program in 1982 ranged from medical and personnel research to topics in physics, chemistry, computer science and the several branches of engineering and applied mathematics and statistics. The selection of topics varied at each Navy laboratory to suit the specific areas of research within the individual laboratories charter assignments while at the same time being chosen so as to be of interest also to the faculty member participants.

Virtually all -- in fact, 93 percent -- of the NSFRP participants in 1982 held the Ph.D. or an equivalent doctoral degree in their field of expertise and approximately one third were assistant professors, one-third were associate and one-fourth were full professors, with the remainder holding other types of academic appointments. Some 29 percent were women or members of minority groups including representatives of almost all categories of the latter, including, in particular, 9 Black Americans. The physical sciences collectively constituted the dominant field of the participants this year at 46 percent followed by engineering at 31 percent and mathematics and the mathematical sciences at 10 percent with the remainder in the life science areas. The ages of the participants again showed quite a spread but the average remained virtually unchanged from the preceding year at 43.

The 1982 NSFRP participants were paid stipends of 5500 dollars for their 10 weeks tenure at their host Navy laboratory plus suitable allowances for travel. The total cost to the Navy of the 1982 program was about 651,000 dollars. Somewhat less than half of these funds were

*Abstracts of 91 reports are presented
in this document.*

provided by ONR while the balance came from the individual Navy laboratories on an agreed prorated basis; more particularly each Laboratory was assigned from 4 to 8 NSFRP participants funded by ONR and was allowed to take at its option an additional number to be paid for out of its own funds, the actual number of such additional appointments in the event ranging from zero at the Naval Medical Research Institute to 22 extra at the Naval Research Laboratory.

Many favorable and even glowing comments and expressions of enthusiasm for the program were received by ASEE and the writer regarding the experiences of the participants and their host Navy laboratories in 1982 and previous years and -- aside from a few minor difficulties experienced at one or two of the laboratories in timely establishment of clearances for a few of the NSFRP participants and a fairly commonly expressed desire by the participants for more remunerative stipends -- ASEE and the writer found no significant problems with administration of the program or with its reception by the individual participants and Navy laboratories involved.

At the end of the summer each NSFRP participant prepared a report on his summer's research at his host Navy laboratory. Abstracts of 91 of these reports are presented later in this document and it is anticipated that many of these will eventually be further developed into professional research papers appearing in the archival scientific literature. Abstracts for the remaining reports on the 1982 program were delayed for various reasons and were not available in time to be included here.

Finally, before the NSFRP participants departed to return to their home colleges and universities, an appropriate certificate was presented to each of them by the Navy and ASEE in recognition of their participation in the 1982 program.

Fallouts from the 1979, 1980 and 1981 Programs

A number of interesting "research fallouts" as we term them of Navy significance have occurred as a result of the 1979, 1980 and 1981 NSFRP programs. Among these it is noteworthy that from the three former programs involving a total of 16 NSFRP participants at 3 Navy laboratories in the summer of 1979, 26 NSFRP participants at 7 Navy laboratories in the summer of 1980, and 59 NSFRP participants at 10 Navy laboratories in the summer of 1981, a total of:

- o 21 research contracts adding up to 414,000 dollars have been awarded to 18 former NSFRP participants for follow on research;
- o 10 former participants have been further employed by their host Navy laboratory as consultants or on intergovernment

personnel act or exempt part-time civil servant appointments and one such participant has become a full-time civil servant at his host laboratory;

and

- o At least 40 papers based on, or continuing, research started under the NSFRP programs have been presented as invited or contributed papers at scientific and engineering meetings of Navy interest and/or have been published in refereed journals or in the conference proceedings of such meetings.

Clearly these accomplishments go a long way towards demonstrating the success of the NSFRP programs in meeting the Navy's objectives set forth earlier.

Organization of the Report

Additional items of interest, factual data, more information on costs and more detailed statistics regarding various aspects of the 1982 NSFRP program are provided in Section II.

The abstracts of the individual NSFRP participants reports on their 10 weeks summer research are presented in Sections III through XII, one section being devoted to each of the ten participating Navy laboratories and full reports, on individual projects can, incidentally, be provided by the writer or ASEE, if desired.

The cumulative compilation of data on the later or subsequent "research fallouts" of Navy interest which have resulted from the 1979, 1980 and 1981 NSFRP programs is presented in some detail in Section XIII.

Finally, a brief outline of plans for the 1983 NSFRP program and plans for continued tracking of future NSFRP program research fallouts are set forth in Section XIV.

Acknowledgements

The writer is indebted to Robert D. Ryan and Gordon Hamilton of ONR for many helpful suggestions and other assistance with administration of the 1982 NSFRP program and wishes to express his appreciation for their efforts. He is also indebted to, and wishes to thank, F. X. (Tim) Bradley and Jeffrey (Jeff) Jarosz of ASEE for carrying out all the many and varied duties of Program Director and Assistant Administrator, respectively for the 1982 NSFRP program for ONR and ASEE. Thanks also are due the Program Coordinators at the 10 Navy laboratories and the Navy scientists and the 97 NSFRP participants that took part in the 1982 program; their names appear later on in this report and their collective help, advice and assistance is herewith acknowledged with pleasure.

II. MANAGEMENT, PERSONNEL, STATISTICAL
DATA AND COSTS FOR
THE 1982 PROGRAM

II. MANAGEMENT, PERSONNEL, STATISTICAL DATA AND COSTS FOR THE 1982 PROGRAM

Administration and Program Execution

The NSFRP program in 1982 was again administered by ASEE for ONR. F.X. (Tim) Bradley, Jr. served as Project Director for the program at ASEE and the writer served at ONR as Scientific Officer.

The 1982 program was advertised by ASEE in the fall of 1981 and announcements of the program were sent to more than 40,000 members of ASEE and the American Association for the Advancement of Science. In addition, announcements were sent separately to about 12,000 deans and department chairpersons in American colleges and universities including coverage of departments of mathematics, physics, chemistry, astronomy, geology, geography, information and communication sciences, statistics, atmospheric and hydrospheric sciences, general sciences, and the social and economic sciences.

Applications received at ASEE in response to the announcements were forwarded to the 10 Navy laboratories, distributed according to the preferred first choice Navy laboratory indicated by the applicants. These were then circulated at each Navy laboratory to find appropriate matches of talents and interests following which the Navy laboratories made their selections and winning applicants were offered appointments to the program by ASEE.

At each of the Navy laboratories a Program Coordinator acted as a focal point for local administration of the program and each NSFRP participant was associated, at the Navy laboratory to which he was assigned, with one or more selected Navy scientists -- referred to in this report as the participant's Research Colleagues.

Preprogram visits of the 97 participants to their assigned Navy laboratories were arranged in order to plan the participant's summer research, to make preliminary arrangements for their association with the Navy laboratory during the summer and to facilitate finding of suitable housing for the participants and their dependents and so forth. These preprogram visits to the participants' Navy laboratories permitted a "running start" on the participants' research in many cases and facilitated efficient use of the participants' and their Research Colleagues' time and energy for the program.

At the end of their ten weeks tenure at their assigned Navy laboratory the participants each received a certificate from ONR and ASEE attesting to his or her successful participation in the 1982 program and each participant prepared a report on his or her summer's work, abstracts of which appear in this report in Sections III through XII as noted previously.

Personnel in the 1982 Program

The address for F.X. (Tim) Bradley, Jr., the Program Director at ASEE and the names and affiliations of the Program Coordinators at the 10 Navy laboratories taking part in the program in 1982 are listed below:

F.X. (Tim) Bradley, Jr.
American Society for Engineering Education
Suite 200
11 Dupont Circle
Washington, DC 20036

David A. Patterson
Naval Research Laboratory

V. D. Schinski
Naval Medical Research Institute

Henry Beyer
Naval Air Development Center

John Wynn
Naval Coastal Systems Center

Eugene P. Cooper
Naval Ocean Systems Center

Bernard Rimland
Naval Personnel Research and
Development Center

Elizabeth Cuthill
Naval Ship Research and
Development Center

Wendell Anderson
Naval Surface Weapons Center

Paul Scully-Power
Naval Underwater Systems Center

Dick Wisdom
Naval Weapons Center

The names and addresses of the participants themselves as well as the names of their Research Colleagues at the Navy laboratories appear on the abstracts of their reports in Sections III through XII and additional statistical information on the participants, including an alphabetical listing of them, is presented along with other data in the following paragraphs.

Some Statistics for the 1982 Program

The 97 NSFRP program participants in 1982 -- 44 of whom were supported by ONR under the basic program and 45 of whom were supported by the Navy laboratories -- were distributed amongst the latter as shown in Table I.

Table I

DISTRIBUTION OF 1981 NSFRP PARTICIPANTS
AT THE NAVY LABORATORIES

<u>Navy Laboratory</u>	<u>Funded by ONR</u>	<u>Funded by Laboratory</u>	<u>Total</u>
NRL	8	23	31
NMRI	4	0	4
NADC	4	6	10
NCSC	4	1	5
NOSC	4	7	11
NPRDC	4	5	9
NSRDC	4	1	5
NSWC	4	4	8
NUSC	4	4	8
NWC	<u>4</u>	<u>2</u>	<u>6</u>
Totals	44	53	97

Indicated separately therein also are the number of participants supported at each Navy laboratory by ONR and the number supported by the Navy laboratories themselves.

The names of the 1982 program participants arranged in alphabetical order along with their ages, academic ranks, departmental affiliations and home colleges or universities and the Navy laboratories at which they spent the summer are listed similarly in Table II below.

DETERMINATION OF SEDIMENT THICKNESS IN NORWEGIAN-GREENLAND SEA

Michael Czarnecki

Department of Ocean Engineering
Florida Atlantic University
Boca Raton, Florida

ABSTRACT

This research centered around the development of a sediment thickness model for the Voring Plateau region of the Greenland-Norwegian Sea. Initial effort involved the acquisition and review of seismic and sediment core data collected during USNS Hayes Cruise 79-16-02. Computer software was then developed which provided a means of reducing the raw seismic data to digital form from which detailed plots of bathymetry, oceanic basement structure and sub-bottom reflectors were generated. Subsequent analysis involved scanning of the data set to locate individual reflecting layers and to specify sediment thickness in terms of two-way acoustic propagation time. Available models of sediment velocity structure were utilized to convert propagation time to sediment depth. Specifically, models derived from a regression analysis of acoustic refraction data collected in previous experiments were incorporated into the model to provide corrected results in units of kilometers. Final stages of the model development involved merging with navigation data to produce the desired output of sediment structure as a function of geographic position.

Research Colleagues at NRL: H. Fleming and R. Feden

1982

MAGNETIC FIBER OPTIC SENSORS, SMALL LIQUID CELLS

David Y. Chung

Department of Physics and Astronomy
Howard University
Washington, DC

ABSTRACT

The research projects related to fiber optics sensor program have been carried out in collaboration with R. DePaula and R. Hickman under the supervision of J. Cole. Several small projects have been carried out. The objective is to make a small liquid cell in such a way that the laser light is coupled in and out with single-mode fiber. A special liquid which is sensitive to magnetic field is then tested with this cell. Faraday rotation of the liquid under the action of A.C. and D.C. magnetic fields was measured. The preliminary results show the working potential of this approach, using direct alignment and self-foc lens techniques, both of which give satisfactory results. But the self-foc lens gives more optical output. In order to use this magnetic liquid with fiber optics cells as magnetic sensor, more work is needed.

The usefulness of small liquid cells for optical studies is also an attractive one since there are applications that only small amount of sample is available (only few nano-liter is needed here). Once the cell is made it can be reused for different liquid samples. However, more data and testing are needed in order to be useful in different applications.

Research Colleague at NRL: J. Cole

1982

STARK EFFECT OF SiOH AND SiH MOLECULES IN SiO₂

Tarak N. Bhar

Department of Electrical Engineering and Computer Science
University of the District of Columbia
Washington, D. C.

ABSTRACT

Multiple internal reflection and a modulation of the charge in the surface via the field effect have been used to study the molecular stark effect in a MOS structure. Hydrogen (H⁺) of a fluence of $2 \times 10^{17} \text{ cm}^{-2}$ was implanted at 95kv into a wet-grown SiO₂ film 1.12/ μm thick on a substrate trapezoid of p-type Si with a resistivity of 5000 ohms. (acceptor density $N_A = 10^{13} \text{ cm}^{-3}$), to study SiOH and Si H bonds in SiO₂: Au film was evaporated on top of the oxide. A light beam passing through the Si trapezoid was totally reflected 18 times at Si-SiO₂ interface and gave a multiple internal reflectance spectrum showing the presence of Si H and SiOH vibrational bands. Two types of voltage modulation were used, a large dc voltage, V_{dc} , with a smaller ac voltage, V_{ac} , superposed, and a strictly ac voltage, V_{ac} . Each modulation procedure produced a different dependence of line intensity.

The SiOH and SiH bands are clearly seen at 3640 and 2260 cm^{-1} . The application of a static (or low frequency) electrical field introduces two types of modification to the ordinary infrared spectrum: (i) variation of the dipole moments already present; and (ii) small stark shifts of the energy levels associated with the ordinary spectrum. Also, with bias voltage, the change in absorption is not symmetrical; the downward lobe increases faster than the upward lobe. Studies were also carried out to study the interface state signal with applied bias voltage but no conclusive result was obtained.

Some unimplanted samples (both p and n type) were also investigated to trace natural hydrogen using multiple internal reflectometry and stark effect phenomena. No stark peaks of SiOH and SiH bonds were noticed. Main problem encountered was the immature breakdown of the oxide layer with increase in voltage. This is possibly due to the leaky (spongy) nature of the oxide. Other problems encountered during this study include the rectification of In-Ga eutectic contact on n-type Si instead of ohmic.

Research Colleagues at NRL: E. Palik, R. Holm and H. Hughes

1982

NUMERICAL HYDRODYNAMIC MODELS FOR THE GIANT HII REGION W49 AND THE DISCOVERY
OF THE ^3He ISOTOPE IN HII REGIONS OF OUR GALAXY

Thomas M. Bania

Department of Astronomy
Boston University
Boston, Massachusetts

ABSTRACT

My summer research activity at NRL focused on several topics which link studies of the interstellar media in galaxies with large-scale galactic structure and star formation. This work resulted in the completion of three drafts of technical papers, two of which have already been submitted to scientific journals, the preliminary calculation of numerical hydrodynamic models for the Giant HII Region W49, and the discovery of the ^3He isotope in several HII regions in our Galaxy. Abstracts, copies, and/or summaries of these various projects are appended to this report. In addition, I established several long-term collaborative ventures: (i) an infrared experiment to search for neutral ^3He emission from planetary nebulae with H. Smith of the Radio and Infrared Astronomy Branch; (ii) a theoretical investigation into the effects of starbursts on galactic structure with L. J. Rickard, another ASEE fellow in the Branch; and (iii) an experiment to measure the ionized gas flow in the W49 star forming region using the VLA with K. Johnston, Head of the Radio and Infrared Astronomy Branch, and J. van Gorkem of the N.R.A.O. Finally, in collaboration with L. J. Rickard, I organized a series of seminars on Current Problems in Galactic Structure to help promote interaction between members of the Space Sciences Division with interests in that area.

CURRENT DRIVEN ION CYCLOTRON INSTABILITY: EFFECTS OF MAGNETIC
SHEAR AND FINITE WIDTH CURRENTS

Pradip Bakshi

Department of Physics
Boston College
Chestnut Hill, Massachusetts

ABSTRACT

Three research topics were addressed during the summer program. The title of the main topic has been given above. The other two topics are: analytical studies on the $E \times B$ instability with an inhomogeneous electric field; and particle dynamics of a collective particle accelerator. Work on these topics can be summarized as follows: (i) Our earlier work on the non-local effects of magnetic shear on the current driven ion-cyclotron instability has been generalized to include finite width current profiles. It has been shown that previous results are recovered if the current width w exceeds the shear length L . The shear becomes less effective as w is decreased and the growth rate attains its local value when $w/L < 10^{-2}$ for typical parameters. (ii) The linear theory of the $E \times B$ instability with an inhomogeneous electric field has recently been developed at NRL (Huba et al), where the growth rates are obtained by a numerical solution of the differential equations. We have developed analytical procedures for the approximate determination of the eigenvalues, and the growth rates thus obtained are in excellent agreement with the numerical results for a wide range of parameters. The analytical approach has the advantage of making explicit the various parametric dependences. And (iii) A Collective Particle Accelerator has been proposed by Friedman at NRL. We have studied the particle dynamics for axial motion under the combined influence of forward and backward waves and a standing wave. Phase space trajectories were computed by numerical integration of the equations of motion and an understanding of the main features was also obtained analytically.

Research Colleagues at NRL: P. Palmadesso and J. Huba

1982

SIMULATION OF TIME DIVISION MULTIPLEXED (TDM) COMPUTER NETWORK

Maurice F. Aburdene

Department of Electrical Engineering
Bucknell University
Lewisburg, Pennsylvania

ABSTRACT

A simulation model of a five system computer network was developed. The systems are part of a data acquisition and processing network. The components of each system are: time division multiplexed bus (TDMB) through which all communication takes place; bus controller which determines the number of time slots in a frame of a bus cycle, duration of a slot, the slot assigned to each component, and the source to destination tables (routing tables); input channels which provide raw data for the data acquisition phase (raw data is packetized); bi-directional communication channels (modems) which transfer raw data from one system to any other system; communication channel 1 which transmits processed reports; communication channel 2 which transmits time critical processed reports; memory which stores processed data; processor 1 which provides data processing of raw data from the input channels of the network; processor 2 which is a system report generator; and buffers associated with the above components.

This was followed by the development of a GASP simulation program to understand and predict the behavior of the network. Network performance characteristics of interest include bus utilization, buffer utilization, and mean packet delay. GASP is a FORTRAN based simulation language and permits the user to write FORTRAN subroutines to aid in the simulation process. The simulation program is composed of twelve user written subroutines. They can be classified as main program, program data input routines, program output routines, and event simulation routines.

Queueing models were developed to predict the length and utilization characteristics of the buffers. Bus slot assignment algorithms were identified but have not been tested.

Research Colleagues at NRL: D. Wahrenberger, J. Fritz, and T. Lefkowitz

1982

III. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL RESEARCH LABORATORY

Washington, DC

Program Coordinator at NRL: D. A. Patterson

1982

Table III

APPROXIMATE PRORATED DISTRIBUTION OF 1982 NSFRP PROGRAM
COSTS AT THE NAVY LABORATORIES
IN THOUSANDS OF DOLLARS

<u>Navy Laboratory</u>	<u>Cost to ONR</u>	<u>Cost to Laboratory</u>	<u>Total Cost</u>
NRL	55.7	149.8	205.5
NMRI	27.8	0	27.8
NADC	27.8	39.1	66.9
NCSC	27.8	6.5	34.3
NOSC	27.8	45.6	73.4
NPRDC	27.8	32.6	60.4
NSRDC	27.8	6.5	34.3
NSWC	27.8	26.0	53.8
NUSC	27.8	26.0	53.8
NWC	27.8	13.0	40.8
Totals	<u>305.9</u>	<u>345.1</u>	<u>651.0</u>

The proportionately higher funding of 305,900 dollars provided by ONR for the basic 44 participants as compared to the 345,100 dollars provided by the Navy laboratories for the extra 53 participants indicated by the tabulated figures reflects the basic overhead costs at ASEE for advertising and organizing the program while the fixed basic charge of 6515 dollars to the Navy laboratories per extra participant for the 53 extra people was based on the participants' stipend of 5500 dollars plus an incremental overhead and travel allowance for each participant estimated to average 1015 dollars per extra person, with as noted above, some slight adjustments in certain special cases.

In connection with these statistics it may be noted also that for the 1982 program, approximately 36 percent of the participants were assistant professors and 94 percent held the doctoral degree in their field of expertise. Mathematics was the special field of expertise of 10 percent of the participants and the physical sciences collectively accounted for 46 percent of the participants followed by the engineering fields at 31 percent and the lifesciences at 12 percent. Almost all areas of the country were represented with the 97 participants coming from about 85 separate institutions located -- as noted earlier -- in 45 of the contiguous states, the District of Columbia, Hawaii and Puerto Rico.

Participation by Women and Minorities

There was substantial participation in the 1982 NSFRP by women and minority group members. In fact out of 97 participants 29 were either women or from minority groups or both. More particularly, 24 were representatives of Black, Hispanic, Oriental or Asian groups and 5 were non-minority women. Of the 24 minority representatives 9 were Black, 14 were of Oriental or Asian backgrounds and one was Hispanic. In addition to the 5 non-minority women appointed to the 1982 program 4 of the minority representatives were women as well as minority members.

In summary, thus 30 percent of all appointees to the 1982 NSFRP were either women or minority members or both and 9 percent were Black Americans.

The distribution of applicants to the 1982 NSFRP program among the various categories of women and minority groups was very similar on a percentage basis to the distribution of appointees noted above and, in particular, out of 24 women applicants to the 1982 program 9 were appointed and out of 24 Black American applicants 9 were similarly appointed.

Costs and Distribution of Support

The full cost to the Navy for the 1981 NSFRP program was approximately 651,000 dollars as noted previously. Of this ONR provided about 306,000 dollars for 44 participants and the Navy laboratories provided about 345,000 dollars for the 53 extra participants shown earlier in Table I. Since not all of the Navy laboratories desired to have more participants than could be paid for by ONR the Navy laboratory contribution came, of course, only from those Navy laboratories which actually took the extra participants.

The approximate distribution of the Navy's costs for the 1982 NSFRP program between ONR and the 10 participating Navy laboratories corresponding to the distribution of participants shown in Table I is set forth in Table III below. The contribution of each Navy laboratory that elected to take extra participants was based on a nominal figure of 6515 dollars times the number of such extra participants with appropriate minor adjustments in this allocation in one or two cases where a lesser figure applied because of special circumstances in those cases.

<u>Participants</u>	<u>Age</u>	<u>Rank</u>	<u>Academic Department</u>	<u>College/University</u>	<u>Navy Lab</u>
Tapia, M.A.	46	Prof	Electrical Eng	U Miami	NADC
Tatum, B.C.	35	Assoc Prof	Psychology	Cornell	NPRDC
Templeton, J.L.	33	Assoc Prof	Chemistry	U North Carolina	NRL
Tillman, C.	49	Assoc Prof	Chemistry	Southern University	NOSC
Uzes, C.A.	43	Assoc Prof	Physics	U Georgia	NCSC
Vechten, D.V.	34	Asst Prof	Physics/Astronomy	Howard	NRL
Varley, R.L.	34	Visit Assoc Prof	Physics	Lehigh	NRL
Vanderah, D.J.	35	Asst Prof	Chemistry	Chatham College	NWC
Wachman, M.	50	Prof	Math	U Connecticut	NUSC
Walker, C.C.	50	Prof	Information Mgmt	U Connecticut	NPRDC
Walsh, P.J.	52	Prof	Physics	Fairleigh Dickinson	NRL
Wechter, M.A.	45	Assoc Prof	Chemistry	SE Massachusetts U	NRL
Weisgerber, F.E.	35	Asst Prof	Civil & Envir Eng	U Cincinnati	NUSC
Williams, W.	36	Prof	Physics	Lincoln University	NRL
Wolf, A.A.	47	Assoc Prof	Physics	Davidson College	NRL
Yfantis, E.A.	37	Asst Prof	Math & Science	U Nevada/Las Vegas	NRL
Yuschik, M.	38	Asst Prof	Elec/Comp Eng	U South Carolina	NRL

<u>Participants</u>	<u>Age</u>	<u>Rank</u>	<u>Academic Department</u>	<u>College/University</u>	<u>Navy Lab</u>
Pandey, R.K.	45	Assoc Prof	Electrical Eng	Texas A&M	NWC
Parchment, O.C.	43	Assoc Prof	Math/Computer Science	Morgan State	NSWC
Paul, M.P.	45	Prof	Electronics/Indus Tech	Alcorn State	NADC
Reed, R.W.	40	Asst Prof	Physics	Penn State	NADC
Rhodes, B.H.	44	Assoc Prof	Math	Villanova	NADC
Richardson, F.S.	42	Prof	Chemistry	U Virginia	NWC
Rickard, L.J.	32	Asst Prof	Physics/Astronomy	Howard	NRL
Riehl, J.P.	33	Asst Prof	Chemistry	U Missouri/St.Louis	NWC
Robinson, E.L.	40	Prof	Physics	Austin College	NRL
Samuel, A.	45	Assoc Prof	Science & Math	St. Paul's College	NMRI
Sanders, T.H.B. Jr.	38	Assoc Prof	Materials Eng	Purdue	NSWC
Sasaki, E.H.	42	Prof	Psychology	California State	NPRDC
Sebrechts, M.M.	31	Asst Prof	Psychology	Wesleyan	NPRDC
SeEVERS, R.E.	47	Prof	Chemistry	So Oregon State	NUSC
Sink, C.W.	39	Prof	Chemistry & Physics	Edinboro State	NRL
Sloan, V.Y.	44	Assoc Prof	Acctg & Decision Sci	Eastern Wash State	NPRDC
Spiteri, C.J.	35	Asst Prof	Elec/Comp Tech	Queensborough Comm	NOSC
Stiffler, A.K.	43	Assoc Prof	Mechanical Eng	Mississippi State	NSRDC
Taggart, G.B.	39	Assoc Prof	Physics	Virginia Commonwealth	NRL
Tamaki, J.K.	27	Asst Prof	Math	U Santa Clara	NOSC

<u>Participants</u>	<u>Age</u>	<u>Rank</u>	<u>Academic Department</u>	<u>College/University</u>	<u>Navy Lab</u>
Hubbard, D.W.	46	Prof	Chem Eng	Mich Tech U	NRL
Johnston, L.H.	64	Prof	Physics	U Idaho	NWC
Jones, W.H.	59	Prof	Chemistry	U West FL	NSWC
Kaufman, M.J.	45	Prof	Chemistry	Emory U	NRL
Ko, F.K.	34	Asst Prof	Textiles & Science	Philadelphia	NADC
Kriegsmann, G.A.	35	Assoc Prof	Eng/Applied Math	Northwestern	NIISC
Landolt, R.G.	43	Assoc Prof	Chemistry	Texas Wesleyan	NRL
LeBlanc, L.R.	43	Prof	Ocean Eng	URI	NIISC
Lind, A.	49	Assoc Prof	Geography	U Vermont	NIISC
Longo, S.A.	39	Assoc Prof	Physics/Comp Sc	LaSalle	NADC
Loo, F.T.C.	55	Assoc Prof	Mech & In	Sam Houston State	NRL
Manka, C.K.	44	Prof	Physics	San Diego State	NOSC
Mann-Nachbar, P.	55	Lecturer	Civil Eng	Texas Tech	NOSC
McLauchlan, R.A.	40	Asst Prof	Mech Eng	U MD School of Med	NMRI
Myers, W.F.	59	Assoc Prof	Microbiology		
Newburg, E.A.	52	Prof	Math	Rochester IT	NOSC
Newton, T.A.	61	Prof	Math	Wash State	NWC
Noodlemar, S.	68	Adjunct Prof	Elec Eng	U Arizona	NSWC
Oliver, F.W.	41	Prof	Physics	Morgan State	NRL
Olson, A.M.	45	Chairman	Math	U Puerto Rico	NSWC

<u>Participants</u>	<u>Age</u>	<u>Rank</u>	<u>Academic Department</u>	<u>College/University</u>	<u>Navy Lab</u>
Durrett, H.J.	34	Assoc Prof	Psychology	SW Texas State	NPRDC
Eastman, R.M.	64	Prof	Indus Eng	U Missouri	NSRDC
Edwards, M.E.	34	Assoc Prof	Physics	Fayetteville State	NRL
Eoll, J.G.	39	Asst Prof	Physics	Lenoir-Rhyne	NSWC
Feng, F.D.	43	Prof	Chemistry	San Diego Mesa	NOSC
Ferguson, E.J.	57	Prof	Indus Eng & Mngmnt	OK State	NOSC
Frahm, C.P.	43	Prof	Physics	IL State	NCSC
Frederick, G.T.	35	Assoc Prof	Biology	Rochester IT	NMRI
Funk, K.H.	29	Asst Prof	Indus & Gen Eng	Oregon State	NPRDC
Gardner, R.M.	34	Asst Prof	Biology	Rochester IT	NMRI
Gattis, J.L.	39	Assoc Prof	Elec Eng	U Arkansas	NCSC
Geraci, J.R.	44	Prof	Pathology	Ontario Veterinary	NOSC
Hagedoorn, A.H.	45	Assoc Prof	Mech Eng	U Central FL	NRL
Hammond, E.C.	43	Asst Prof	Comp Sc & Sc Educ	Morgan State	NRL
Hand, C.W.	46	Assoc Prof	Chemistry	U Alabama	NRL
Hargrove, A.	59	Assoc Prof	Elec Eng	Tuskegee Inst	NCSC
Hedgepeth, T.W.	46	Asst Prof	Math	Virginia Union	NSWC
Heisler, R.	40	Prof	Eng	Walla Walla	NRL
Heller, M.W.	56	Assoc Prof	Physics	Colorado State	NOSC
Htun, K.M.	45	Assoc Prof	Mech Eng	U Hawaii	NRL

Table II

1982 NAVY SUMMER FACULTY RESEARCH PROGRAM PARTICIPANTS

<u>Participants</u>	<u>Age</u>	<u>Rank</u>	<u>Academic Department</u>	<u>College/University</u>	<u>Navy Lab</u>
Aburdene, M.F.	35	Assoc Prof	Elec Eng	Bucknell	NRL
Ahrnsbrak, W.	39	Assoc Prof	Geoscience	Hobart & Wm Smith	NUSC
Bakshi, P.M.	45	Prof	Physics	Boston College	NRL
Bania, T.M.	32	Asst Prof	Astronomy	Boston University	NRL
Berkhout, J.I.	44	Prof	Psychology	South Dakota	NADC
Bhar, T.N.	41	Assoc Prof	Elec Eng & Comp Sci	Dist Columbia	NRL
Bohren, C.F.	41	Assoc Prof	Meteorology	Penn State	NOSC
Boyle, A.B.	42	Prof	Engineering	Purdue	NSRDC
Bredeson, J.G.	41	Prof	Elec Eng & Comp Sci	U Oklahoma	NADC
Bukowski, J.V.	29	Asst Prof	Sys Eng	U Pennsylvania	NADC
Chiang, J.	42	Prof	Chemistry	SUNY, Oneonta	NRL
Chung, D.Y.	40	Prof	Physics	Howard	NRL
Coyne, P.J.	33	Asst Prof	Eng Science	Loyola	NSWC
Creese, R.C.	40	Assoc Prof	Indus Eng	West Virginia U	NSRDC
Czarnecki, M.F.	34	Asst Prof	Ocean Eng	Florida Atlantic U	NRL
Davey, K.R.	29	Asst Prof	Elec Eng	GA Inst Tech	NCSC
Donaldson, B.K.	49	Prof	Aerospace Eng	U Maryland	NSRDC
Douglass, C.H.	34	Asst Prof	Chemistry	Trinity, Wash DC	NRL
Drake, A.D.	37	Asst Prof	Elec Eng & Comp Sci	U Conn	NUSC
Dumas, P.E.	41	Prof	Chemistry	Trenton State	NADC

LASER PHOTOLYSIS OF FORMAMIDE

Charles H. Douglass, Jr.

Department of Chemistry
Trinity College
Washington, D.C.

ABSTRACT

The laser photolysis-laser induced fluorescence technique has been used to investigate the UV photolysis of formamide (CHONH_2). Photolysis of formamide vapor using a focused ArF laser (Lumonics 860) produced NH in a variety of electronic states. Laser induced fluorescence (LIF) using a dye laser (CMX-4) was used to determine the electronic state of the NH. Ground state NH ($X^3\Sigma^- \rightarrow A^1\pi$ transition at $\lambda = 336$ nm. Photon dependence measurements show that production of ground state NH is a two photon process. NH in the $a^1\Delta$ state was observed by exciting the $a^1\Delta \rightarrow c^1\pi$ transition at $\lambda = 325$ nm. The observation of a rise time for this fluorescence and the increase in intensity when N_2 buffer gas is added indicate that this state is not a primary photolysis product. Prompt emission observed without the LIF probe laser indicates that NH is also formed in the $A^1\pi$ state. This state results from a three photon process. A small amount of prompt emission due to the $c^1\pi$ state is also observed. A spectrum of the induced fluorescence from the $X^3\Sigma^-$ state has been recorded as well as dispersed spectra of the prompt emission from both the $A^1\pi$ and $c^1\pi$ states.

Research Colleagues at NRL: J. McDonald, H. Nelson and L. Pasternack 1982

PHOTOACOUSTIC TECHNIQUES FOR PROBING LASER WINDOW
DEFECTS AND COATING DEGRADATIONS

Matthew E. Edwards

Department of Physics
Fayetteville State University
Fayetteville, North Carolina

ABSTRACT

The development of lasers with power radiation densities has placed stringent requirements on reflective mirror coatings and on defect-free low-bulk-absorption windows. We discuss a photoacoustic technique for observing the mirror coatings and windows. Our technique utilizes the process of placing the sample directly in contact with a piezoelectric crystal which indicates the degree of absorption from the impinging radiation onto the sample via the heating and subsequent expansion that takes place in the crystal. The system incorporates an Argon Ion laser at 488nm with an output power of 1 watt.

Research Colleague at NRL: G. Trusty

1982

FINITE ELEMENT METHODS FOR LUMPED-PARAMETER EQUIVALENT
CIRCUIT ANALYSIS FOR UNDERWATER SOUND TRANSDUCERS

A. Henry J. Hagedoorn

Department of Mechanical Engineering and Aerospace Sciences
University of Central Florida
Gainesville, Florida

ABSTRACT

An eight hour short course was developed and conducted to familiarize the transducer design staff at NRL with finite element concepts and principles as they may be applied to lumped-parameter equivalent circuit analysis for underwater sound transducers. A demonstration program in BASIC on the Hewlett Packard 85 desktop computer was developed to demonstrate the steps involved in the implementation of a finite element analysis. The conclusion was reached that the finite element capability would definitely be useful to the transducer design laboratory at NRL and a tentative list of requirements for the program was specified.

Research Colleague at NRL: T. Hendriquez

1982

DOSE DEPENDENCE OF SINGLE EVENT UPSET RATE IN MOS RAMS

Ernest C. Hammond, Jr.

Department of Comprehensive Science and Science Education
Morgan State University
Baltimore, Maryland

ABSTRACT

The importance of dose dependent studies on Single Event Upset Rate in MOS RAMS is of crucial importance to the defense of the nation, particularly if the nation's enemies have perfected, more or less, high energy ion beams which would mean that their inertial guidance system would be vulnerable to external erratic changes. With the development of the space shuttle and its impending civilian and military implications, it will encounter many electronic fields, solar winds, and very, very high energy cosmic rays which may penetrate the protective covering of the craft and its computers and other instruments such as electronic devices such as the Dynamic RAM. Thus, studies of this nature are of great relevance to the reliability in our space and military ventures.

Research Colleagues at NRL: A. Knudson and A. Campbell

1982

THE REACTION OF ATOMIC FLUORINE WITH METHANOL

Clifford W. Hand

Department of Chemistry
University of Alabama
University, Alabama

ABSTRACT

In general terms, the research carried out was an investigation into the reaction of atomic fluorine with methanol. Preliminary results were available giving a tentative value for the branching ratio k_{1a}/k_{1b} of the reactions transforming $F + CH_3OH$ to $HF + CH_3O$ and $F + CH_3OH$ to $HF + CH_2OH$ and further experiments were performed to improve the reliability of this estimate. The value of the branching ratio has now been shown to be 0.25 ± 0.05 . Several improvements were made to the apparatus and instrumentation in use in the laboratory. These were: (i) Construction of a new reactor incorporating two Butler optical baffles; (ii) Design and construction of electronic circuitry for measurement and control of gas flows of .01 sccs or less. In the final phase of research a technique (involving monitoring of chemiluminescent emission) was developed for determination of the overall stoichiometry of the reaction $F + CH_3OH$.

A WIDEBAND FREQUENCY DOMAIN BEAMFORMER FOR COHERENT ACOUSTIC WAVES

Rodney Heisler

School of Engineering
Walla Walla College
College Place, Washington

ABSTRACT

Based on recommendations of the 1978 Active Adjunct Undersea Surveillance Workshop in Washington, D.C., a sea experiment to resolve critical issues in AAUS has been scheduled for March 1983 and March 1984. An important element of this test is measurement of temporal coherence of surface and bottom reverberation from broadband transmissions. Statistics will be gathered on fluctuations of the coherence envelope in time (range), angular and doppler domains. Of interest are dependencies on range, sea state, bottom features and transmitted waveform and bandwidth.

A linear array of 128 hydrophones will be towed to collect data on hydro-acoustic pressure. Each phone will be sampled at 1024 Hz and the data preprocessed by a PDP 11/34 before being stored on magnetic tape. A second PDP 11/34 with a FPS-120B array processor will perform some signal analysis at sea but the bulk of the processing will be done later at NRL on a VAX 11/780.

A necessary part of both the sea and subsequent laboratory processing is a software beamformer. This involves the addition of time shifted hydrophone data to form antenna beams at designated look angles. Under ASEE sponsorship, a frequency domain beamformer was developed and programmed. The beamformer runs entirely within the FPS-120B array processor and uses the host computer primarily for data movement; hence, achieving near real-time performance. This particular beamformer program is distinguished in its speed and ability to retain information on wave coherence. Other interesting features are its use of subsampled, base-banded input data and its facility to process long duration signals by performing time domain reconstruction following short length frequency domain processing.

Research Colleagues at NRL: E. Franchi, M. Weber, and F. Erskine 1982

CRACK CLOSURE MEASUREMENTS IN MARINE CORROSION FATIGUE

Ko M. Htun

Department of Mechanical Engineering
University of Hawaii
Honolulu, Hawaii

ABSTRACT

Crack closure measurements were made on wedge-opening-loaded (WOL) specimens of HY-130 steel base plate in marine corrosion fatigue. Crack opening loads were measured using a conventional crack-mouth clip gage affixed to the front face of the specimen by screw-mounted knife edges and also by a crack-tip closure gage mounted to the side of the specimens by elastic bands. At regular periodic crack length-to-width (a/w) intervals, load (P) versus crack-opening--displacement (COD) data were recorded autographically and digitally for computerized data processing. This process was repeated successively for specimens in ambient room air, substitute ocean water freely corroding and substitute ocean water with a zinc cathodic couple. Both methods of measuring crack opening loads, crack-mouth versus crack-tip, provided equivalent results, but the crack-tip gage provided a sharper indication of crack closure for autographic display. However, crack opening loads obtained via the conventional crack-mouth gage displayed less scatter when the data were analyzed by means of computerized data processing. Crack opening loads under Region II fatigue crack growth conditions were little affected by substitute ocean water under freely corroding conditions. However, the addition of a zinc couple, which produced calcareous deposits, substantially raised crack opening loads.

Research Colleagues at NRL: S. Gill, M. Jolles and T. Crooker

1982

TURBULENCE IN WAKES

Davis W. Hubbard

Department of Chemistry & Chemical Engineering
Michigan Technological University
Houghton, Michigan

ABSTRACT

Two tasks related to the general wake project were selected. First, a library project was done while the equipment needed for the second task was being completed. The library project was to make a survey of foam and aeration literature addressing questions about the mechanism for aeration at air-water interfaces, about the mechanism for foam formation in wakes and waves, and about the general characteristics of foams--bubble size distribution, foam lifetime, and foam breakage mechanisms.

Following completion of the library studies the main task for the 10-week fellowship period was to study turbulence in the wake behind a flat plate being towed through still water in the towing tank at the Marine Technology Division including, in particular, wake turbulence measurements. Experimental details are presented in the full report and additional results will be obtained in planned follow on studies and experiments.

Research Colleagues at NRL: O. Griffin and T. Swain

1982

KINETICS OF GASEOUS METHOXY RADICALS

Myron Kaufman

Department of Chemistry
Emory University
Atlanta, Georgia

ABSTRACT

The methoxy radical, CH_3O , is an important intermediate in many combustion systems where its dominant reactions are often with other free radicals. In order to study the kinetics of free radical reactions of CH_3O , methods for producing CH_3O free of contaminants and for measuring very low absolute concentrations of CH_3O are required. We have accomplished the above, using the $\text{F}+\text{CH}_3\text{OH}$ reaction, with F_2 added to remove CH_2OH product.

Laser induced fluorescence was employed to monitor relative CH_3O concentrations at levels below 10^{-11} cm^{-3} .

In using the $\text{F}+\text{CH}_3\text{OH}$ reaction, the unusually rapid reaction of atomic fluorine with CH_3O (and perhaps CH_2OH) must also be considered. Extensive computer modeling of the kinetic equations describing this system were carried out in order to establish the reaction conditions under which the branching ratio, k_{1a}/k_{1b} , could be reliably measured and under which the system could be used to calibrate the laser-induced-fluorescence method for absolute CH_3O concentrations.

Visible chemiluminescence is observed in the $\text{F}+\text{CH}_3\text{OH}$ system and its maximum persistence is identified with the stoichiometric endpoint of the reaction. Reaction stoichiometry in the presence of F_2 provides an alternative means of measuring the branching ratio. Spectroscopic analysis of the visible emission shows it to be dominated by high overtone ($\Delta v=4, 5$, and 6) bands of HF, originating from levels at least as high as $v=9$. These emissions are attributed to the extremely exothermic $\text{F}+\text{CH}_3\text{O}$ and $\text{F}+\text{CHO}$ reactions.

Research Colleagues at NRL: D. Bogan, W. Sanders and C. Hand

1982

DECONTAMINATION: SIMULANT - HYPOCHLORITE
STUDY/LITERATURE REVIEW AND PRELIMINARY RESEARCH

Robert G. Landolt

Department of Chemistry
Texas Wesleyan College
Forth Worth, Texas

ABSTRACT

Research conducted at the Naval Research Laboratories in the summer of 1982 focused on several objectives relative to decontamination of chemical warfare (CW) agents. Work carried out included: (i) A review of the literature and laboratory experimentation to identify candidate simulant compounds for use with decontamination formulations based on hypochlorous acid/hypochlorite ion; (ii) experimentation to characterize the pH variation observed during application of the Self-Limiting Activated Solution of the hypochlorite protocol developed at NRL; and (iii) exploratory research on the use of Parathion as a chemical simulant for the so-called 'G' agents in hypochlorite decontamination with an emphasis on the relationship between reactant concentrations, pH, and reactivity of the system.

Research Colleagues at NRL: R. Taylor and R. Little

1982

ZEEMAN EFFECT AND LINE SHAPE CALCULATION FOR THE CARBON V MULTIPLY
IN LASER PLASMAS

Charles K. Manka

Department of Physics
Sam Houston State University
Huntsville, Texas

ABSTRACT

The wavelength (227.1-227.8 nm) and small Stark coefficient of the C V multiplet make it attractive for studies of the magnetic fields in laser plasmas using the Zeeman effect. For magnetic fields >100 kG, "intermediate field" effects must be taken into account for both amplitude and frequency (wavelength) of the Zeeman components as the multiplet tends toward the Paschen-Bach effect. The σ - and Π - polarized line components are calculated and exhibit striking "signatures" for magnetic fields ~ 500 kG. These "signatures" are shown and the effects of absorption, Stark-Doppler, and instrumental broadening on these signatures are calculated and compared with recent NRL experiments.

IRRADIATION STUDIES ON $\text{CaF}_2:\text{Mn}$ THERMOLUMINESCENT DOSIMETERS

Frederick W. Oliver

Department of Physics
Morgan State University
Baltimore, Maryland

ABSTRACT

Experimental measurements on the properties of thermoluminescent dosimeters (TLD) were made. Several types of manganese activated calcium fluoride ($\text{CaF}_2:\text{Mn}$) dosimeters were investigated. Samples looked at were 35 mil chips, 2 and 5 mil teflon discs. The purpose of the research was to observe the damage effect of repeated irradiations on the TLD's and to measure the buildup thickness of aluminum necessary for electronic equilibrium.

Research Colleague at NRL: L. August

1982

PROBLEMS IN STAR FORMATION

Lee J. Rickard

Department of Physics and Astronomy
Howard University
Washington, DC

ABSTRACT

Research was undertaken on several topics under the general category of problems in star formation. This work resulted in the completion of three drafts of technical papers, two of which have already been submitted to scientific journals, and the preparation of one partial draft to be completed this fall. Abstracts and copies of these drafts are appended to the report. In addition, several long-term collaborative ventures were started including (i) a VLB experiment in collaboration with B. Geldzahler of the Radio and Infrared Astronomy Branch at NRL; (ii) a theoretical investigation into the effects of starbursts on galactic structure with T. M. Bania, another NSFRP fellow in the Radio and Infrared Astronomy Branch; and (iii) a plan for including particular extragalactic targets of scientific importance into some upcoming balloon-based infrared experiments to be mounted by the Radio and Infrared Astronomy Branch. Finally, in collaboration with T. M. Bania, a series of seminars on *Current Problems in Galactic Structure* were organized by the writer for the general edification of the members of the Space Sciences Division at NRL with interests in that area.

Research Colleague at NRL: P. Schwartz

1982

TIME-FREQUENCY REPRESENTATIONS OF ONE-DIMENSIONAL SIGNALS

E. Larry Robinson

Department of Physics
Austin College
Sherman, Texas

ABSTRACT

One-dimensional signals which have information content are most often displayed as a function of either time or frequency. These two representations are, of course, related; they constitute a Fourier Transform pair with time and frequency as conjugate variables. Often one is interested in both the frequency and temporal properties of the signal, and several two-dimensional representations have been developed. Those two-dimensional distributions for which optical processing systems have been reported include the Wagner Distribution Function, the Ambiguity Function, and the Instantaneous Power Spectrum.

The work undertaken in this project consisted of participating in the efforts of a group which had been studying two-dimensional representations for some time. Specifically the work had three major emphases: (i) an attempt was made to sharpen the interpretations given to certain of these time-frequency distributions; (ii) an experimental study of two new two-dimensional representations was carried out; and (iii) computations related to these new representations were made. The first of these three efforts met with success; a better understanding was obtained, but additional work in this area might be profitable. The second and third efforts were somewhat more successful in that the new time-frequency representations studied do have certain advantages over other representations for particular classes of signals. In the case of amplitude-modulated signals, the two representations correspond to mean-frequency selective correlation and to difference-frequency selective convolution. The experimental portion of this effort was carried out with a versatile acousto-optic processing system which, unlike other reported systems, is capable of computing the three previously-known time-frequency distributions as well as the new representations.

Research Colleagues at NRL: R. Athale, J. Lee, and H. Szu

1982

DEVELOPMENT OF RAPID METHODS OF DETECTION OF WATER-BORNE
PATHOGENS IN THE ENVIRONMENT AND OF ANTIBODIES IN HUMAN SERA

William F. Myers

Department of Microbiology
School of Medicine
University of Maryland
Baltimore, Maryland

ABSTRACT

This study is part of a broader effort to produce antigens from some of the more common water-borne and enteric pathogens for the rapid determination of antibody levels in human populations. The same antigens and the same serological methodology are being applied to the development of monoclonal antibodies which will be used for the rapid detection and isolation of these pathogens in environmental specimens. During the 10-week tenure of this program, carbohydrate antigens were isolated from 8 legionella sero-groups. These antigens were filter sterilized, partially purified by column chromatography, and characterized with respect to reactivity with established homologous sera, carbohydrate content, and presence or absence of protein and endotoxin. Although the 8 antigens differ widely in antigenic specificity, they are apparently released into the culture supernatant fluids in the same manner and are isolated by identical procedures. At least 4 can be combined without loss of sensitivity or antigenic specificity. The possibility of combining all 8 as a screening antigen mixture is now being investigated. Good progress has been made in the development of monoclonal antibodies.

Research Colleagues at NMRI: H. Westfall and E. Weiss

1983

HORMONAL REGULATION OF HEPATIC METHYL TRANSFERASE ACTIVITY

Russell Gardner

Department of Biology
Villanova University
Villanova, Pennsylvania

ABSTRACT

A recent report indicated that glucagon in low concentrations increases the activity of phospholipid methyl transferase in rat hepatocytes. Since this could be important in the mechanism of hormone action and may possibly be altered by bacterial endotoxin, we decided to make further studies in this area. We repeated the work on hepatocytes, but were unable to show any increase in methyl transferase upon adding glucagon. Therefore, we used liver slices, which responded to glucagon, isoproterenol, and cAMP by an increase in glucose production. Our initial data indicate no change in methyl transferase activity, despite the fact that the liver slices were responding to the addition of hormones in vitro. The lack of methyl transferase stimulation suggests that phospholipid methylation may not be generally involved in glucagon receptor or β -receptor activities in the liver, although this mechanism may be of importance in other tissues.

DEVELOPMENT OF ANIMAL MODEL SYSTEMS FOR
ETIOLOGICAL AGENTS OF DIARRHEAL DISEASE

Grover T. Frederick

Department of Biology
Rochester Institute of Technology
Rochester, New York

ABSTRACT

Electron microscopy (EM) was used to study the cellular morphology of Campylobacter jejuni grown in vitro, and to investigate the interaction of this microorganism with the intestinal tracts of rabbits and mice following experimental infection. Transmission EM (TEM) and scanning EM showed C. jejuni to be highly pleomorphic. Spiral shaped cells, containing a homogeneous cytoplasm, were the predominant form in young cultures (18 hours). Aged cultures were characterized by the development of spheroplast forms with the inner cytoplasmic membrane well separated from the outer membrane. The cytoplasm of these spheroplasts was heterogeneous. It is hypothesized that as the culture aged, breakdown of a peptidoglycan layer between the outer membrane and the cytoplasmic membrane resulted in a loss of the cellular rigidity needed to maintain the spiral shape. All C. jejuni strains investigated lacked pili. Most had no capsule, with the exception of one strain that formed large, mucoid colonies. The presence of flagella was highly variable from strain to strain, being concomitant with in vitro motility. Several examples of flagellated C. jejuni were found in the intestinal lumen of rabbits where organisms were injected directly into the small intestine. Very little evidence of tissue invasion was observed in these infected rabbits, even when C. jejuni organisms were in direct contact with the microvilli of the intestinal lumen deep in the villous crypts. In a few instances, microorganisms were trapped within a mucous layer contiguous with the epithelial surface. In rabbits with clinical signs of intestinal epithelial cell damage, TEM revealed the presence of C. jejuni in areas of cell damage, both in the lumen and within damaged tissue. However, no organisms were found beneath the epithelial cell layer. These in vivo results led us to hypothesize that the tissue damage following experimental infection may be due to a toxin produced by the C. jejuni organism and not to a direct physical invasion of healthy tissue. The effects of C. jejuni culture filtrates on in vitro mammalian cell cultures are now being investigated.

TEM of intestinal tissue of mice experimentally (orally) infected with C. jejuni showed no tissue invasion by this organism. A few bacterial cells were found in the lumen, but very little tissue damage was observed and the presence of C. jejuni was not consistently demonstrated in these damaged areas. Thus the mouse does not appear to be a good animal to use in a model system.

Research Colleagues at NMRI: R. Walker, J. Coolbaugh, S. Stewart,
B. Caldwell, L. Myhal and D. Rollins 1982

IV. ABSTRACTS OF PARTICIPANTS RESEARCH
at the
NAVAL MEDICAL RESEARCH INSTITUTE
Bethesda, Maryland

Program Coordinator at NMRI: V. D. Schinski

1982

IMPROVING THE SPEECH QUALITY OF AN LP SYNTHESIZER

Matthew Yuschik

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University of South Carolina
Columbia, South Carolina

ABSTRACT

Speech production is usually decomposed into two functionally independent units, a source and a modulator. Although this simplification ignores the effects of the vocal tract on the lungs, it enables both components to be analyzed individually without the confusing effects of their interaction. By examining the processes underlying human speech production and perception, important physical characteristics and constraints of the speech signal can be identified which permit critical evaluation of the performance of the synthesizer model. Linear Predictive Coding (LPC) is one such model that has the advantage of a low data rate for parameterization, but shows some weaknesses in speech quality.

The present report begins with an overview of the human auditory system so as to identify those properties which permit perceptual discrimination of speech sounds. All descriptions are presented in terms of three primary acoustic dimensions (intensity, frequency, and duration). Then a discussion of the acoustic properties of phonemes is undertaken to identify the articulatory mechanisms of the vocal tract and the sound sources which govern speech production. The third section considers the analytic representation of source signals and previous implementations for speech sources and is concluded with a description of mixed sources which more precisely reflect the manner of human sound generation. The fourth section introduces the method of line spectral pairs (LSP) and shows how it can be viewed as a model of the modulator stage of the human vocal tract. Its mathematical description is directly developed in terms of LP coefficients. The advantages and disadvantages of this method are then compared to standard LP encoding. Finally, a comprehensive new model using mixed sources and the LSP filter is presented as a viable means to achieve improved speech quality at a decreased data rate.

ELECTRON PARAMAGNETIC RESONANCE IN IRRADIATED SILICATE
GLASSES WITH HIGH WATER CONTENT

Albert Allen Wolf

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Davidson College
Davidson, North Carolina

ABSTRACT

Previous work on sodium silicate glass suggested that, while samples containing no water turn dark on exposure to x-rays or electron beams, samples containing water (even in amounts as small as one percent) remain clear. The new investigation showed that all samples darken if exposed to x-rays while immersed in liquid nitrogen, but this darkening then disappears as the glass is warmed and disappears fastest in water-bearing samples. Even the dry sample becomes clear if warmed to about +200°C.

Paramagnetic resonance spectra indicate that the presence of titanium as a trace impurity in the specimens is responsible for these results. A detailed explanation of the roles played by titanium and by water will involve examining the absorption spectra as a function of temperature in the infrared through ultraviolet range and coordinating these results with those obtained from paramagnetic resonance. This phase of the investigation is underway and will continue through the present academic year.

Research Colleagues at NRL: E. Friebele, Jr. and D. Griscom

1982

MAGNETO-TRANSPORT STUDIES OF SI N-CHANNEL METAL-OXIDE-SEMICONDUCTOR
FIELD EFFECT TRANSISTORS

Willie William

Department of Physics
Lincoln University
Lincoln University, Pennsylvania

ABSTRACT

Measurements were made of the conductance and transconductance of Si n-channel metal-oxide semiconductor field effect transistors (MOSFETs) in high magnetic fields. The temperature range included data points at about 2K, 77K and room temperature, with fields up to 8 T. The fields were provided by the Bitter solenoids of the NRL High Magnetic Field Facility. The primary point of interest in the study was to determine the field effect mobility. Currently, mobilities over 20,000 have been reported by other laboratories. However, MOSFETs produced at NRL have not consistently reached these values. The study hoped to improve the mobility by selected variation of the production scheme used to make the FETs. Although none of the NRL MOSFETs studied showed the high mobilities, a new production run was in progress at the close of the summer program. This run is expected to show much higher mobilities.

Research Colleague at NRL: R. Wagner

1982

FUEL SEDIMENT ANALYSIS

Margaret Wechter

Department of Chemistry
Southeastern Massachusetts University
North Dartmouth, Massachusetts

ABSTRACT

The technique of x-ray photoelectron spectroscopy (XPS, ESCA) was applied to the analysis of sediments which are formed in fuel and which degrade fuel storage stability. It was hoped that the ESCA work would help to elucidate the structural features of oxygen and nitrogen functionalities in the sediments, and that some quantitative information about the structure and composition of the materials could be obtained.

Samples studied included sediments formed in a Navy Paraho Scale II DFM fuel by doping fuel samples with 2,5-dimethylpyrrole and stressing the mixtures for periods of 4 to 28 days at 80°C. Several naturally occurring sediments were also investigated.

Information obtained from ESCA spectra tended to indicate general similarities and differences rather than to yield specific structural information. Atomic ratio results, however, show indications of changes in sediment composition over time and indicate that the composition of various fractions associated with a given sediment may vary. Comparisons of the ESCA spectra of induced vs natural sediments indicated some differences particularly in the nitrogen spectra.

Some solubility studies were performed to determine effects of stress-time on solubility. The sediment fractions remaining after solvent treatment were also subjected to analysis by ESCA. A comparison of their spectra with the sediment spectra taken before solvent treatment indicated differences in the atom ratios. Structural feature comparisons were inconclusive.

PHOTOLYSIS OF $\text{Fe}(\text{CO})_5$ ADSORBED BY GAS AT 77K

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ABSTRACT

It is shown experimentally that pentacarbonyl iron can be adsorbed and desorbed on a GaAs substrate at low temperatures and photolyzed with ultraviolet illumination to yield an Fe film deposit. A simple double beam laser technique is used to monitor the sequence of events during adsorption, desorption, and ultraviolet light illumination. This work is the first evidence for the direct formation of a thin metal film on a cold semiconductor surface by ultraviolet photolysis of a condensed organo-metal.

Research Colleague at NRL: N. Bottka

1982

LAGRANGIAN SIMULATION OF FLOW PAST A CYLINDER

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Bethlehem, Pennsylvania and New York, New York

ABSTRACT

Some preliminary results of the viscous flow of fluid about a cylinder of infinite length utilizing a two-dimensional Lagrangian simulation model are presented. The connection of this problem to recent developments in statistical mechanics where a controversy has evolved concerning the correct form of the constitutive relations (Fick's law, the Newton viscosity hypothesis, etc.) in two-dimensional fluids is also discussed. The computer simulation (SPLISH) assumes an incompressible fluid and the effects of viscosity are included via a finite difference form of the usual Navier-Stokes equation. The model uses as a finite-difference mesh, a general connectivity triangular grid. This grid allows for reconnections and vertex additions and deletions which permit accurate long-time solutions of complicated flows.

SUPERCONDUCTIVITY IN 2 DIMENSIONAL GRANULAR NbN

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ABSTRACT

A study of properties of the granular superconductor niobium nitride, NbN. Superconducting systems exhibit a transition at temperatures below 20 K into a state with no DC electrical resistance. Granular systems have a manifestly inhomogeneous microscopic structure. This, in combination with the quantum mechanical nature of superconductivity, make such granular systems inherently interesting scientifically. Moreover, from a practical point of view, they offer the promise, currently near realization, of millimeter wave detectors and the future possibility of tunable millimeter wave generators when the problem of how to achieve the phase coherence necessary for superradiance is solved. NbN is a particularly good choice of system because of its relatively high superconductive transition temperature and its refractory character. The work at NRL on it has been in progress for some 3 years and is in quite a mature phase wherein successful fabrication techniques and the characteristic behavior of samples have been established. Various new experiments were conducted and sufficient results have now been obtained to enable a coherent image of the system to be formed.

Research Colleagues at NRL: D. Gubser and W. Fuller

1982

METAL MEDIATED REACTIONS OF CARBON DIOXIDE AND CARBON MONOXIDE

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ABSTRACT

Carbon oxides are omnipresent gases that require monitoring and manipulating to provide desirable controlled atmospheres. Reactions of carbon dioxide with metal complexes are relatively rare, and John Cooper and his group at Naval Research Laboratories have uncovered an enticing chemistry with cupric methoxide, pyridine and carbon dioxide. To further this project pilot studies of other copper alkoxide derivatives and CO₂ have been explored. Reactions with early transition metals and carbon dioxide have also been surveyed during this period. Electrochemical characterization of reversible molybdenum carbon monoxide carriers was completed to provide background information for potential carbon monoxide measuring devices. Cyclic voltammograms of a solid product formed from cuprous chloride and pyrrolidine (provided by R. Panayappan) were recorded and compared to data obtained for cuprous and cupric chloride with and without added pyridine. Cuprous pyrrolidine materials have useful conducting properties of Naval interest.

Research Colleagues at NRL: R. Nowak and J. Cooper

1982

THEORETICAL STUDIES OF CORRELATED HOPPING
CONDUCTIVITY AND DIFFUSION IN SOLIDS

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ABSTRACT

Conductivity and diffusion in a variety of solid-state systems occurs via hopping-like motions of ions and atoms. Examples of such systems include fast ion diffusion in solid electrolytes and the diffusion of hydrogen in metals and on metal surfaces. The present studies have focused on a theoretical description of such hopping conductivity and diffusion which includes the important influence of correlations and interactions between the moving particles. The correlations and interactions arise both from the restriction that two particles cannot simultaneously occupy the same lattice site and also from direct interactions between the particles such as Coulomb interactions.

The present studies are proceeding in three stages. In the first a model is being formulated for these systems, and techniques are being developed to solve for their properties. Phenomenological rate equations are being related to a description of diffusion based on the kinetic Ising model. The resulting model is being solved for diffusion constants and conductivity as functions of concentrations, correlations and interactions. In the second stage the results of this formalism will be applied to describe fast ion conduction in β'' -alumina and related systems. For such systems Monte Carlo studies have indicated that the effects of correlations and interactions are important. Lastly, it is planned to consider extensions of this work to additional classes of systems, in particular to hydrogen diffusion in metals. As a result of the small mass of hydrogen, its motion in metals shows strong electronic, vibrational and quantum effects, and a full description of its motion is therefore more complex than that of heavier particles.

Research Colleague at NRL: T. Reinecke

1982

DIRECT COMPOUND CLASS QUANTITATION FOR JP-5 JET TURBINE
FUELS BY HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

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ABSTRACT

One important specification of jet fuel is the compound class composition (the relative amounts of saturated and aromatic hydrocarbons) because the composition directly affects the performance properties of a fuel. No simple technique is currently available to provide quick reliable quantitation of this property. This study shows that direct analysis of jet fuels by high performance liquid chromatography can provide quantitative data that is in good agreement with FIA and LC/GC methods. In addition, the time required to obtain the analysis is reduced from several hours to less than ten minutes.

The method utilizes typical HPLC equipment. The mode of detection chosen is change in refractive index, and each compound class has approximately constant refractive index. The detector response for each class is calibrated by separating standard mixture prepared from representative compounds in the class. Initial results of quantitation of several known mixtures of these compounds demonstrate the validity of the method when the system is calibrated with the actual compounds present in the mixtures to be analyzed. However, the results of direct analysis of four jet fuels gave consistently high values for the saturate fraction.

The detector response was subsequently recalibrated with an actual jet fuel as the standard. This jet fuel standard was prepared by separating a typical jet fuel into three compounds classed by HPLC. These fractions were collected, purified and recombined in known quantities to provide a standard fuel that models more closely the fuels to be analyzed. Subsequent analysis of eight jet fuels produced results that are in agreement with other methods.

The findings of the study show that HPLC can provide a reliable, rapid alternative to the current methods of jet fuel analysis. Further work is planned to evaluate the potential application of this technique of analysis to diesel fuel and gas oils. Work is continuing to determine if different chromatographic conditions can improve the accuracy and precision of this method.

Research Colleague at NRL: D. Hardy

1982

EXPRESSION OF MEMBRANE-BOUND ANTIGENS ON HUMAN T-CELL
LINE MOLT-4 AND THEIR CELL CYCLE PHASE RELATIONSHIP

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ABSTRACT

Relationship between the expression of cell surface antigens and cell cycle phases (G1, G2M and S) was investigated using Human T-cell line MOLT-4. Antibodies 9.6, 10.2 and Leu 1 were employed. Acyties fluid was used for negative controls.

Antibody-antigen binding was assayed using fluorescein conjugated IgG (G/M FITC) and analyzing the fluorescence patterns generated by a fluorescence-activated cell sorter (Coulter EPICS V) coupled to MDADS (Coulter EPICS V) coupled to MDADS (Coulter) and PDP 1134 (digital computers). Propidium iodide DNA staining procedure was used to obtain cell cycle phase distribution of the cells.

Cell elutriation and cell cycle blocking techniques were employed to obtain discrete cell populations from specific cell cycle phases. Hydroxyurea (Hu) was used to block the cells at G1-S boundary enriching the G1 population. Coupled elutriation fractionation provided approximately 85% pure G1 cells. Elutriation fractionation of cell cultures not treated with Hu provided enriched populations of S (63% purity) and G2M (27% purity). Unpreturbed, exponentially growing MOLT-4 cell populations had a distribution pattern of about 45% in G1, about 49% in S and about 60% in G2M at any given time. All elutriated fractions in G1 through G2M phases (flow rates 16 ml/min through 22 ml/min) provided cells which were 90-95% viable. Dead cells and debris were collected at lower flow rates.

In general the cell line was positive to all three antibodies. Antigens for 10.2 seem to be distributed evenly through the cell population. However, for 9.6 there was a progressive increase in positivity from G1 through G2M.

The study of the regeneration of surface antigens after their removal by trypsinization indicated a strong cell cycle phase relationship for both 9.6 and 10.2 antibodies. Concurrent microscopic observations (J. Maples, NMRI) are complementary. A thorough analysis of the data is continuing.

Research Colleagues at NMRI: J. Woody and J. Maples

1982

V. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL AIR DEVELOPMENT CENTER

Warminster, Pennsylvania

Program Coordinator at NADC: Henry Beyer

1982

INCORPORATION OF HUMAN PERFORMANCE MEASUREMENT CAPABILITY
IN THE NADC CREST FACILITY

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University of South Dakota
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ABSTRACT

The NADC CREST facility is a fixed base generic flight simulator intended for the comparative evaluation of novel displays and of computer-mediated command and control systems. In its April, 1982 configuration, CREST could not be used to quantify the effects of display and control-system changes on flight operations since no scoring systems, standard missions or tasks had been provided. Evaluations of such changes were based on poorly documented subjective debriefings. The report documents the software development and experimental designs defined during the summer of 1982 to provide for a quantitative evaluation capability for display and control configurations presented in the CREST simulator.

The contents of the report include a review of CREST display technology and software capability, and a description of the human performance measures added to the system during the summer of 1982. These measures were based on an analysis of reaction times to stimuli embedded in a formal mission scenario and a further analysis of two dimensions of RMS tracking error scores. Further reduction of tracking error data has been provided for, including averaged error attenuation profiles following standardized interrupt points.

The report concludes with a survey of experimental designs appropriate for the CREST research program, taking into account the number and skill levels of the subjects available and a detailed outline of a modular systems expansion of CREST capability for precise human performance documentation.

Research Colleagues at NADC: W. Helm, P. Linton, and N. Warner 1982

DATA TRANSFER ANALYSIS OF THE V BUS

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ABSTRACT

The V Bus is a candidate proposed by Sperry Univac for the interconnection of VHSIC devices. The high speed data transfer requirements of VHSIC devices rule out the use of many existing bus structures. The V Bus family is a digital bus architecture that is specifically tailored to interface between VLSI/VHSIC technology chips, cards and subsystems. The architecture of the V Bus allows the use of a varying number of lines (or pins) to suit the data transfer requirements. The number of lines can vary from two for low speed (pin restrictions) to 53 pins for high speed requirements. The report examines the V Bus operation and data handling characteristics. A brief examination of queueing theory and simulation is presented to explain the modeling of the random process of message generations, message lengths, data transfer and performance criteria. Several V Bus configurations, number of Masters and message lengths are examined and plotted. An interpretation of the results is also included with various recommendations.

THE IMPACTS OF BUILT-IN-TEST ON THE MAINTAINABILITY OF AVIONICS SYSTEMS

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ABSTRACT

Maintainability is a design characteristic of equipment which influences the rapidity, ease and accuracy with which equipment or systems can be restored to operational status following failure. In the design of avionics systems, it is a commonly accepted philosophy that maintainability can be improved (and hence systems made more mission-ready) by increasing the level of BIT (Built-In-Test) capabilities in such equipment. The trend has been towards specifying more sophisticated BIT with each new weapons system procurement. However, there has been little research performed to determine if this increasing use of BIT has indeed improved maintainability. Further, to date, virtually all studies on BIT impact on maintainability have been based on theoretical models of BIT capabilities. These models have not been assessed for accuracy against actual Fleet data.

The present research effort addressed this issue by hypothesizing the existence of a U-shaped relation between extent of BIT and the resultant maintainability burden. The implications of the truth of such a hypothesis would be the existence of a maintainability-optimal level of BIT. To test the hypothesis, nine equipments present on eight different aircrafts and representing three levels of BIT capability were selected for study. Current data from which measures of maintainability burden could be extracted were gathered from the Navy's Aviation 3-M Data System. Extensive statistical analysis confirmed the hypothesis. Mean maintenance man-hours per maintenance action have not decreased with increasing levels of BIT. Further, with increasing extent of BIT, the percentage of false fault indications rises dramatically. Hence, functioning equipment is frequently removed from service unnecessarily, seriously degrading mission readiness.

The unique features of this research effort were the use of actual Fleet data and the recognition of the differing impacts of BIT at the organizational and intermediate levels of maintenance. These aspects of the research study have raised a variety of new questions about the impacts of BIT on maintainability and have suggested numerous avenues for further investigation.

DEVELOPMENT OF NEW CORROSION INHIBITORS SYSTEMS

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ABSTRACT

Sodium molybdate, sodium borate, sodium tungstate, sodium chromate and sodium vanadate in conjunction with nitrate ion were investigated for their ability to provide corrosion protection for 1020 steel in high chloride and low pH media. Although these compounds have been recognized for their ability to inhibit corrosion in the pH range of 6 to 11, their individual effectiveness diminishes at lower pH. The effectiveness of the systems studied were evaluated employing electrochemical polarization studies to determine the degree of passivity each test system provided. Experimentally, ASTM procedures were followed in determining both the open circuit potentials and the current potential polarization scans. In all experiments the 1020 steel samples were studied in 1% NaCl solution whose pH was adjusted to 2 with HCl. Initial experiments confirmed that molybdate, borate, tungstate, nitrite and vanadate provide little corrosion protection in chloride media. Polarization scans for these species were essentially identical to the curves obtained for the NaCl media without any inhibitors. However, when either molybdate, borate, tungstate or vanadate were used in conjunction with nitrite ion, excellent corrosion protection was obtained. The results of these experiments clearly indicated that nitrite ion provides a synergistic effect when used in conjunction with either borate, molybdate, tungstate or vanadate. These results will enable the development of a new class of combination inhibitors that are effective at low pH values and relatively high chloride concentrations. Effort was also devoted to obtaining electrochemical data that would help to elucidate the mechanism operative in providing the observed corrosion protection. Studies were undertaken to determine both the stoichiometry and the electrochemical parameters of the system investigated.

CHARACTERIZATION OF AN INTEGRATED 3-D FABRIC
FOR STRUCTURAL COMPOSITES

Frank Ko

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Philadelphia, Pennsylvania

ABSTRACT

The overall objective of this summer research program was to develop a dialog between the textile (fibrous structure) engineers and the aerospace (composite) engineers. The specific objective of the project was to establish a framework for the characterization of the structure and properties of "Magnaweave." Due to its 3-D integrated structural nature and an ability to assume complex structural shapes, composites reinforced by this fabric have potentially higher levels of transverse strength and impact resistance compared with conventional laminated composites.

The specific tasks accomplished in this summer project include: (i) The establishment of a set of terminology and technical requirements for specifications for the 3-D fabrics. This document will facilitate the communication between designer, manufacturer, and users; (ii) characterization of the structural geometry of the 3-D fabrics experimentally using metallic tracer yarn (for x-ray pictures) and models. Computer code was also developed to illustrate the spacial arrangement of the yarns; (iii) establishment of constitutive relationship for graphite, Kevlar, and 3-2 glass based on large number of tensile tests at various gage lengths; (iv) the structure-property relationship of the 3-D structure was examined by measuring the tensile, shear, and flexural strength of S-2 glass/rubber modified epoxy composites of various structural geometries; and (v) establishment of prediction equations for the tensile strength of the 3-D structures. In connection with this experiment verifications were carried out by testing the component graphite yarns; the 3-D preform and epoxy resin composite.

Research Colleagues at NADC: L. Gause and J. Alper

1983

ADA LANGUAGE REVIEW

Stephen A. Longo

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Philadelphia, Pennsylvania

ABSTRACT

My objective was to become acquainted with the Department of Defense (DOD) language, Ada. In order to do this it was necessary that I also become familiar with the UNIX operating system, its various editors and some C language statements.

In the course of my studies, I discovered and documented a number (~20) of compiler errors. These problems initiated my learning the language C. The result was a number of shell programs that aided my studies of Ada (program allowing multi-background Ada processes and a "pretty print" for Ada using SED and LEX). I wrote a generic math package (float point - 7 digit resolution).

It is anticipated that the work will be summarized in two tutorial publications.

Research Colleague at NADC: G. McClellan

1982

VLF RADIO PROPAGATION MODEL CALCULATIONS

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ABSTRACT

Radio communication at very low frequency (VLF, 3 to 30 KHz) is characterized by low attenuation rates, high path stability, and high signal-to-noise ratio especially because of the guided nature of the waves between the conducting ground and the reflecting ionosphere.

Peter Bannister has proposed a model of VLF radio propagation by exciting the whispering gallery modes in the earth-ionosphere waveguide medium, and the Center's planned balloon-to-balloon cross-link experiment will help to examine the field strength values as predicted by this model.

Calculations have been carried out to examine the extent of the predicted field strength variations by including the effects of additional parameters, e.g., the height variation of either the transmitting or receiving antennas, or both, and the geomagnetic field on the field strength formulation.

Research Colleague at NADC: J. Pye

1982

THE MEASUREMENT OF ULTRASONIC WAVES WITH A LASER INTERFEROMETER

Robert W. Reed

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University Park, Pennsylvania

ABSTRACT

This research project involved the use of a state-of-the-art laser interferometer to characterize the surface excursions of a specimen undergoing excitation by acoustic waves. The heterodyning type interferometer is capable of sensing ultrasound in the frequency range of 100 KHz to 10 MHz. The optical system includes a microprocessor controlled light beam scanner for aiming the laser beam at the desired location on the specimen surface. The electrical output of the interferometer is processed by a Tektronix Model 7854 which is interfaced to a Tektronix Model 4054 graphics computer. The entire measurement system is operated under computer control. A major effort was directed towards improving the software which controls the operation of the scanning laser interferometer and which also changes the data to a useful form. I have also written the programs which generate graphic displays of the acoustically driven surface motion.

A unique feature of the laser interferometer as a sound detector is the ability to look at very small portions ($\sim 1 \mu\text{m}$ diameter) of the sound wavefront and obtain a precise measure of the amplitude of the surface excursions. For specularly reflecting surfaces the amplitude resolution is $\sim 0.2^\circ\text{A}$, while for diffusely scattering surfaces the resolution is $\sim 5^\circ\text{A}$. Preliminary results show that sound beams generated by a variety of 5 MHz transducers vary considerably in amplitude across the sound wavefront. This result, if further verified, is of considerable interest.

Research Colleague at NADC: W. Scott

1982

ANALYTICAL MODEL TO DETERMINE FORCE LEVEL REQUIREMENTS
FOR A CONTINUOUS STATION-KEEPING MISSION

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ABSTRACT

A single military unit, such as an aircraft, can perform a specified activity activity or mission for a limited period of time. In a total force level a set of such units supports the continuous performance of the activity through the process of successive unit replacement.

Such units are subject to failure, resulting in an inability to perform the activity. Emergency replacement units may or may not be available and performance-degraded units can often be restored to activity-capable status.

An analytical model has been formulated to evaluate missions of the kind just described. Measures of effectiveness include estimates of unit availability and of mission continuity. Model inputs reflect unit performance, operating procedures, geography, environment, and the unit maintenance/repair processes.

The model described has been implemented and applied to the assessment of force level requirements for the Navy's TACAMO Mission.

Research Colleagues at NADC: F. Scheetz, M. Kuszewski and J. Phillip
1982

AN INVESTIGATION OF FAULT-TOLERANT DISTRIBUTED MULTIPLE-PROCESSOR
NETWORK ARCHITECTURE FOR AVIONIC SYSTEMS

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ABSTRACT

The availability of inexpensive, highly versatile microprocessors has made it possible to design a cost-effective, fault-tolerant distributed multiple-processor network for avionic systems, as it would provide better performance, reliability, availability, expandability and modifiability and require less maintenance while offering lower overall life-cycle cost than conventional systems do. The report aims at investigating various generic architectures and making comparative analysis from various points of views, makes recommendations for such an approach and points out various problems that need to be tackled before a specific architecture and approach are chosen.

Research Colleague at NADC: R. Mejzak

1982

VI. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL COAST SYSTEMS CENTER

Panama City, Florida

Program Coordinator at NCSC: John Wynn

1982

CABLE DYNAMICS OF A MOORED MINE CABLE PULLED PAST A CUTTING CABLE
AND INTEGRAL TECHNIQUES TO DETERMINE FIELDS IN CONDUCTING MEDIA

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Atlanta, Georgia

ABSTRACT

The dynamics of a catenary pulled over a second high tension wire have been determined and the nonlinear equations have been numerically solved (4th order Runge-Kutta). The tension and position were determined for the buoyed cable in a quasi-two-dimensional analysis as a function of time. Both theory and numerical results were reported.

The second phase of work was bent on determining, via integral techniques, the magnetic field created by a fluctuating current dipole in a conducting medium. The main directive has been in verification of the technique to cases where known analytical results exist. The two cases of primary interest were the horizontal and vertical dipoles. Verification of lateral wave prediction is appearing. Exact convergence has not yet been seen but the problem area appears to have been identified in the matrix inversion process used and eventual convergence seems likely.

The technique's principal virtue lies in its ability to translate volume sources to an interfacial boundary. The source term and secondary induced currents are then removed from the conducting medium. Discretization is stepped down from order N^3 to N^2 ; this step down is a must for unbounded spatial problems such as being considered here. Because the boundary conditions can be identically matched at the interface, the technique appears to be applicable to high frequency problems as well.

Research Colleagues at NCSC: J. Barnes and A. Summey

1982

VIII. ABSTRACTS OF PARTICIPANTS RESEARCH
at the
NAVAL PERSONNEL RESEARCH AND DEVELOPMENT CENTER
San Diego, California

Program Coordinator at NPRDC: Bernard Rinland

1982

THE ISOLATION OF ^{60}Co AND ^{65}Ni FROM LARGE VOLUMES OF SEAWATER

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ABSTRACT

A method was developed for isolation of ^{60}Co and ^{65}Ni from seawater. The procedure involves the introduction of 1-nitroso-2-naphthol dissolved in acetone into seawater. Owing to the insolubility of this reagent in aqueous solution, a fraction crystallizes. The distribution of radionuclides is favorable toward isolation with the crystals formed. Under the condition established ^{60}Co is recovered quantitatively and ^{65}Ni is recovered to the extent of ~75%. Moreover, the methodology is adaptable to an available large volume sampler such that these nuclides should be isolatable from kilo-liters of seawater in about 0.25 hours.

Research Colleague at NOSC: H. Weiss

1982

FINITE STATE MACHINES IN PROTOCOL VALIDATION

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Santa Clara, California

ABSTRACT

In this paper we develop terminology and notation in order to facilitate the analysis of the interface protocol by finite state machines. The composite machine and its associated directed graph are constructed and analyzed. Automated validation techniques are discussed using the composite machines that check for deadlocks and infinite loops.

We focus attention on the interface between the DTE and DCE over the no time delay, empty medium abstraction of the channel with possible message loss and errors. Over a no time delay channel, it becomes irrelevant whether the mode is half-duplex or full-duplex.

Research Colleagues at NOSC: C. Warner, R. Merk, and G. Brown

1982

PROPAGATION OF ELASTIC WAVES IN A FINITE CYLINDER

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ABSTRACT

Solutions of the fundamental equations of linear elasticity which represent traveling waves in a cylinder of infinite length have been known for over a century. Solution of the corresponding problem for a cylinder of finite length has so far not been found. Research project was undertaken to solve the fundamental equations of elasticity for a finite cylinder under appropriate boundary conditions. Solutions were obtained in terms of Laplace transforms under two different sets of boundary conditions. These solutions are of such complexity that inversion of the transforms can only be attempted by numerical methods on a large computer. The transforms are in the form of Fourier series with coefficients which are solutions of a characteristic equation involving modified Bessel functions of the transform variable. No general theory for the numerical inversion of Laplace transforms exists at present. The author is currently surveying the literature on inversion of the Laplace transform and soon plans to begin numerical experiments on the RIT main frame computer which is expected to lead to a satisfactory conclusion.

EXTENDED HYDROMECHANICAL AND BEAMFORMING-ANALYSIS AND
DESIGN STUDIES RELEVANT TO HORIZONTAL AND VERTICAL
SONAR LINE ARRAY CONFIGURATIONS FOR ADVANCED AUTONOMOUS ARRAY

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ABSTRACT

Work begun during summer 1981 at the Naval Ocean Systems Center was continued relevant to the hydromechanical, hence, acoustical performance behavior of various versions of the drifting of free-floating wet end of the Advanced Autonomous Array. By mutual agreement with NOSC the following six areas were defined and addressed during Summer 1982: (i) Modeling of the Naval Underwater Systems Center's array and comparing its behavior to that for the NOSC array; (ii) Validation of the array (wet end) model using current and array shape measurements made during deployment of NOSC array; (iii) Methods of providing mechanical support analysis of wave actuated horizontal array stretcher including design modifications; (iv) Calculation of array directivity index and beam patterns for a given differential-with-depth current profile; (v) Supervision of hydromechanical wet end model installation on a NOSC HP-1000 digital computer system; (vi) Investigation and implementation of finite element analysis of the three-dimensional dynamic response of the array wet end subject to transient, depth-varying environmental current loading. Specific accomplishments in each of these areas are detailed briefly in the full report.

Research Colleagues at NOSC: T. Higbee and P. Hanson

1982

STOCHASTIC MODELS TO IMPROVE TARGET TRACKING

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San Diego State University
San Diego, California

ABSTRACT

An approach to target tracking is considered which would use a probabilistic model to generate target paths conforming to known constraints. The object is to be able to assign probabilities, as a function of time, to possible target positions. A stochastic differential equation known as the Ito equation is examined for suitability as such a model. This equation is distinguished by a white noise random perturbation term. As such, it is a generalization of an equation originally used to model Brownian motion. An overview of the subject area is presented -- an introduction to the theory, the literature, and important results. Familiarity with solution properties has two-fold importance for investigators. Certain properties can be used to determine whether the results which the model can provide are consistent with operational data. For example, the solution to the Ito equation must be a Markov process, i.e., "the future will be independent of the past for known present." Is this characteristic of target behavior? Other properties may prove useful in handling the model. For example, under quite general conditions the Ito equation describes a diffusion process. In fact, the transition probability density function for the solution to the Ito equation satisfies a diffusion equation. There is a large body of literature on the analytic and numerical treatment of diffusion equations. The question of solution properties and what they imply is gone into in some detail. It is suggested that the next step in a continuation of this study should be an examination of information that is available about target behavior, with attention directed to those aspects which can be checked against known general properties of model behavior. If the Ito equation passes such an initial test of suitability, then consideration could be given to the possibility of formulating the tracking problem as a two-point boundary value problem. The report devotes some attention to the question of adapting results available for initial value problems to the two-point boundary value case.

Research Colleague at NOSC: J. Bond

1982

TRANSPORT PROPERTIES OF InGaAs THIN FILMS

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Fort Collins, Colorado

ABSTRACT

The Seebeck coefficient, electrical resistivity and Hall coefficient of a thin film of $\text{In}_{.53}\text{Ga}_{.47}$ as deposited on semi-insulating InP were measured from 4.2 to 300 K. The measured resistivity and Hall coefficient agreed with previously measured values. Measured values of the Seebeck coefficient for InGaAs are not available in the literature for comparison. However, a preliminary analysis of the results of this investigation indicates that at higher temperatures, another scattering mechanism(s) such as alloy scattering or space charge scattering plays a significant role in addition to optical-mode phonon scattering. There was a strong approximately exponential magnetic field dependence of the Hall coefficient and electrical resistivity at 4.2 K.

Research Colleague at NOSC: A. Nedoluha

1982

OBSERVATIONS OF PLANKTONIC BIOLUMINESCENCE IN THE EUPHOTIC ZONE
OF THE CALIFORNIA CURRENT, AND SETTING UP A TWO-DIMENSIONAL
RAPID SCANNING FLUORIMETER FOR PATTERN DETECTION OF ORGANIC
MATERIALS IN THE OCEAN

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San Diego Mesa College and University of California at San Diego
San Diego, California

ABSTRACT

The distribution of bioluminescence, temperature, salinity, chlorophyll-a, pH, oxygen, and nutrients were measured at a station ($33^{\circ} 46' N$, $119^{\circ} 36' W$) in the California current from 17 July to 20 July 1982. The depth distribution of bioluminescence showed a marked day-night change which was consistent over the sampling period. The night time maxima were at the surface while the daytime maxima were between 30-40 meters. Also, night time bioluminescent intensity was about 40 times greater than during the day. The shapes of these distributions seemed independent of the absolute intensity of bioluminescence. The depth distribution was also insensitive to advection inferred from a changing T-S relationship. The night time depth distribution broadened during a period of high wind. Day to night differences in the color spectrum at the depth of maximum bioluminescence suggest the type of organisms that are present. The depth at which maximum bioluminescence was detected during the day generally coincided with the depth of the chlorophyll maximum.

Research Colleague at NOSC: A. Zirino

1982

OPTICAL PROBLEMS IN THE MARINE ENVIRONMENT

Craig F. Bohren

Department of Meteorology
Pennsylvania State University
University Park, Pennsylvania

ABSTRACT

The following research tasks were undertaken at NOSC during the summer of 1982: (i) consulting on submarine periscope wakes and on the aerosol and humidity structure beneath maritime stratus clouds; (ii) development of computer programs for scattering calculations; (iii) three seminars: one at the Visibility Laboratory, Scripps Institution of Oceanography; one at NOSC; and one at the Naval Weapons Center, China Lake, as part of a two-day visit there; (iv) a tutorial lecture on Stokes parameters and Mueller matrices; (v) proposal review.

Research Colleagues at NOSC: J. Richter and H. Hughes

1982

VII. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL OCEAN SYSTEMS CENTER

San Diego, California

Program Coordinator at NOSC: E. P. Cooper

1982

ACOUSTIC SCATTERING AND CLASSIFICATION OF UNDERWATER OBJECTS

Charles A. Uzes

Department of Physics
University of Georgia
Athens, Georgia

ABSTRACT

The summer research program involved three distinct projects: (i) a study of surface waves using a subset of the fluid-elastic body boundary conditions as Dirac constraints, (ii) the development (with R. Hackman) of a modified T-matrix scattering formalism appropriate for the description of elastic scattering of acoustic waves by elongated bodies and shells, and (iii) the development of a classification algorithm for the analysis of backscattered returns of in-house experimental data. The content of the latter two are documented in three internal IR/IED research proposals submitted with R. Hackman to NCSC. The former study is documented in an abstract submitted to the November, 1982 American Acoustical Society Meeting in Orlando, Florida.

Research Colleague at NCSC: R. Hackman

1982

PARTIAL STATE FEEDBACK BY SOLUTION OF THE INVERSE REGULATOR PROBLEM

Andrew Hargrove

Department of Electrical Engineering
Tuskegee Institute
Tuskegee Institute, Alabama

ABSTRACT

Good partial state feedback design eliminates the need for state estimators. A linear time invariant controllable system can be equipped with partial state feedback if the augmented system is found to be stabilizable with the partial feedback gain. Kalman's rule that the return difference must be not less than unity results in expressions that give elements of the feedback gain matrix. The fact that Q , the tracking performance index, is nonnegative provides additional expressions for evaluating the feedback gain matrix. Computer aids are suggested.

Research Colleagues at NCSC: J. Wynn, E. Freeman, and G. Dobeck 1982

IMAGE PROCESSING AT NCSC

Jim L. Gattis

Department of Electrical Engineering
University of Arkansas
Fayetteville, Arkansas

ABSTRACT

This report is actually three reports under one cover: (i) techniques of Image Processing; (ii) the Design of an Image Processing Facility for NSCS; and (iii) the Aydin Image Display System. The first report is a philosophical description of image processing research with the AQS-14 data used for examples. The report discusses general preparation of the data for processing, histogram analysis of the data, spatial frequency analysis, and grey level slicing. Four aspects of simulation as it relates to image processing are also presented. The report points out the need and usefulness of system evaluation, test image evaluation, and then presents methods for determining the direction that image processing should take for both human processing and machine processing. Several suggestions for processing of AQS-14 data are presented.

The second report analyzes the current image processing facilities at NCSC, discusses the possible use of central site computer facilities and provides a detailed conceptual design of a complete image processing laboratory. The physical plant required for the laboratory is presented. The complete hardware system is outlined with an individual description of each major piece of equipment and its use. Software requirements and personnel requirements are also presented along with a discussion of the general capabilities that the laboratory system should possess. The report makes specific recommendations for NCSC.

The third report describes the Aydin image display and presents the new Aydin driver (ADNGAT) written by the author. The driver is documented extensively and confusing or missing details of the Aydin display are clarified. An interactive program to exercise the Aydin and its driver were also developed. This program is useful in teaching researchers how to use the Aydin, help them understand its internal operations, and finally, provide a means of performing diagnostics on the Aydin system. It exercises all capabilities of the Aydin. Three other small programs provide data for calibrating the intensity portion of the Aydin system.

Research Colleagues at NCSC: T. Matthews and C. Kenton

1982

DIRECTIONAL ANALYSIS OF SURFACE OCEAN WAVES
USING A SUPERCONDUCTING MAGNETIC GRADIOMETER

Charles P. Frahm

Department of Physics
Illinois State University
Normal, Illinois

ABSTRACT

Superconducting magnetic gradiometers permit the simultaneous measurement of changes in the five independent magnetic field gradient components at a point. When the gradient changes correspond to the induced magnetic field gradients produced by surface waves propagating in the earth's magnetic field, the resulting time series contain information about the directional spectrum of the surface disturbance. This research effort was directed at extracting an estimate of the directional spectrum of surface waves from such gradiometer time series. The effort consisted of two parts: (1) a verification of the transfer functions relating surface wave amplitudes to magnetic field gradients induced at a point below the sea floor and (2) a determination of the angular spectrum estimator using an appropriate estimation criterion.

Research Colleagues at NCSC: G. KeKelis and W. M. Wynn

1982

CHRONOMETRIC MEASUREMENT OF INTELLIGENCE

Thomas A. Boyle, Jr.

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Purdue University
West Lafayette, Indiana

ABSTRACT

The goal of the project was to explore application of work reported by C. R. Brand at the University of Edinburgh, to the task of assessing recruits and making initial duty assignments for Navy personnel. My part in this was in the adaptation of microcomputer-based equipment to be used in place of the tachistoscope-based equipment heretofore used by Brand. This involved setting up and checking out the microcomputer and its auxiliaries, liaison with suppliers, instructing others in the use of the equipment, providing a modicum of programming support and performing some pilot testing of personnel.

Although our work was set back because of regrettable delays in receiving equipment, the project appears to be advancing on a reasonable schedule. It is my understanding that C. R. Brand will extend use of the equipment in testing Navy and Marine recruits. With one exception, i.e. a computer program presently in preparation by Life Sciences Associates, all the new facilities appear to be ready.

In addition to the personal benefit from my work in chronometric measurement, I have had many stimulating and enlightening contacts at NPRDC. I was especially fortunate to have B. Rimland as my mentor. His broad range of interest and understanding enriched my summer immeasurably. Moreover, during the delay while waiting for equipment, it was my good fortune to receive introductions to the work of others at NPRDC. I am especially indebted to J. R. McBride and C. D. Wetzel for their introduction to the computer adaptive testing work presently underway. This work is quite closely related to my long-standing involvement in programmed achievement testing.

Finally, a work of appreciation is due T. M. Duffy, J. H. Wolfe, and J. W. Warrington for the time spent in acquainting me with their work. J. W. Warrington and his staff were especially helpful in assisting me in using the NPRDC computer facilities.

Research Colleague at NPRDC: B. Rimland

1982

A CRITICAL ASSESSMENT OF THE COMPUTER ADAPTIVE TESTING SYSTEM:
JUSTIFICATION, STRATEGY AND HUMAN FACTORS IMPACT

Herman John Durrett, Jr.

Department of Psychology
Southwest Texas State University
San Marcos, Texas

ABSTRACT

This report describes possible problems associated with the justification, implementation strategy and human factor aspects of the development of a Computer Adaptive Testing (CAT) system. The CAT system is intended to replace pencil-and-paper versions of the Armed Services Vocational Aptitude Battery (ASVAB) at all military enlistment processing centers by 1985. Although this system has noteworthy benefits, such as reduced testing time and improved psychometric precision, possible problems may exist in the areas of reliability and security. It is difficult to implement a computer system that is as reliable as pencil and paper. Also, in a time of full mobilization, sabotage of the testing apparatus by reluctant enlistees would be almost impossible to prevent. Assuming these problems can be overcome, contractors should be encouraged to design the system to meet existing human factors guidelines for military systems. Possible alternative plans for a phased development of adaptive testing are also discussed.

Research Colleagues at NPRDC: J. McBride, J. Lee, B. Sympson and F. Vachino

1982

CIVILIAN EMPLOYEE MOTIVATION, GOAL SETTING
AND PERSONNEL IMPLICATIONS OF NISTARS

Earl J. Ferguson

Department of Industrial Engineering and Management
Oklahoma State University
Stillwater, Oklahoma

ABSTRACT

Cooperative research on a continuing investigation concerning civilian employee motivation using goal-setting theory for purposes of increasing productivity was undertaken. The basic study began in July 1981 and is scheduled over a three-year period. In addition, a new research study was begun to investigate the personnel implications of NISTARS. This research is to continue for approximately three years. The acronym NISTARS means Navy Integrated Storage Transfer and Retrieval System. A general statement outlining the intent of the study is attached to the full report. Basically, NPRDC is developing an understanding of the effects on employees who are confronted with a major technological innovation. Finally, a seminar for NPRDC personnel was conducted to acquaint them with the basics of Automated Storage and Retrieval Systems (ASRS) which is state-of-the-art technology in large warehousing operations, and additional effort was made to acquaint researchers with recent industry efforts to enhance employee productivity using alternate/group incentives.

Research Colleagues at NPRDC: B. Rimland and R. Penn

1982

APPLICATIONS OF COGNITIVE SCIENCE TO NAVAL COMMAND AND CONTROL

Kenneth H. Funk II

Department of Industrial and General Engineering
Oregon State University
Corvallis, Oregon

ABSTRACT

Preliminary research was conducted to investigate applications of concepts from cognitive science in the naval command and control environment. A knowledge organization formalism was developed and documented in a paper to be presented at the IEEE International Conference on Cybernetics and Society. Work is proceeding on a system which utilizes this formalism as the basis for an Intelligent Tactical Assistant to aid in the identification of radar contacts.

Research Colleague at NPRDC: R. Kelly

1982

PEAK-DETECTION ANALYSIS OF O1 AND O2 VISUAL EVENT-RELATED
POTENTIALS WITH BINOCULAR AND MONOCULAR STIMULATION AND
COLORED CHECKERBOARD STIMULI

Edwin H. Sasaki

Department of Psychology
California State College
Bakersfield, California

ABSTRACT

Peak-detection analysis of visual event-related potentials (VERP) recorded from the left and right occipital sites, O1 and O2, respectively, were completed for 24 subjects. The study involved four stimulus conditions (black-and-white, black-and-green, and black-and-blue 5-mm checkerboard patterns), three viewing conditions (binocular, monocular-left eye, and monocular-right eye), and two sessions in one run. In addition, six subjects participated in a second run, and three subjects participated in a third run; the three runs were approximately one month apart. The peak-detection analysis utilized peak-to-peak amplitude measurements with a 10% maximum peak-to-peak amplitude criterion and a ± 20 msec latency criterion. These data are being analyzed to determine individual differences in VERP responses to different colored stimuli, the effect of colored stimuli on the VERP, and the stability of the VERP over time. Work on this analysis is a continuation of efforts started during Summer 1981 and will be continuing.

In addition, complete documentation was developed for all hardware and software used in the biotechnology laboratory for data acquisition, display, and analysis. Familiarization with the equipment and procedures for biomagnetic recording of event-related fields (ERF), the state-of-the-art technology for psychophysiological research, was accomplished.

Research Colleague at NPRDC: G. Lewis

1982

A COGNITIVE ANALYSIS OF INTERFACE DESIGN
FOR COMPUTER AIDED TRAINING

Marc M. Sebrechts

Department of Psychology
Wesleyan University
Middletown, Connecticut

ABSTRACT

This project consisted of an analysis of cognitive issues in interface design and an application of the emerging principles to a computer package for the training of navigational skills. In designing computer aids, it is important to maximize instruction on the content area while minimizing the need for substantial computer-specific knowledge. An analysis was conducted to evaluate the information processing demands placed on a user of such computer aids. The major areas of concern included the structure of computer menus, the types of user input, the constraints on user interaction, the focus of attention, the type of information displayed, and the organization of task goals. The resultant cognitive principles were then implemented as part of a computer package that should help students in learning the use of a maneuvering board, a standard navigational tool. Some of the same principles were also applied to the development of a computerized editor to be used by instructors for creating their own data bases.

Research Colleague at NPRDC: J. Hollan

1982

A FIVE-STEP APPROACH TO PLANNING

V. Yvonne Sloan

Department of Accounting & Decision Science
Eastern Washington University
Cheney, Washington

ABSTRACT

The concept of Long Range Planning (LRP) has created much interest in the business community during the past 20 years. It is both hailed as a savior in turbulent times and labeled as a waste of time. Some of the payoffs and pitfalls of planning are discussed, then a five-step approach to developing and implementing a planning process is discussed. Some comments and suggestions regarding the planning activities at NPRDC are made.

WAGE INCENTIVES AND WORKER PRODUCTIVITY
IN A SHORT-TERM EMPLOYMENT SETTING

Boyd C. Tatum

Department of Psychology
Cornell College
Mount Vernon, Iowa

ABSTRACT

The study was an investigation of the effects of wage incentives on worker productivity and attitudes in a short-term employment setting. The employees were 130 males and females of mixed race and nationality hired to code the responses to a set of questionnaires onto computer-scored answer sheets. Seven different shifts of employees were hired to work five consecutive four-hour days. Shifts 1-5 received a fixed rate of pay (\$4.40 per hour) plus wave incentives for worker output which exceeded a pre-determined standard rate of work. The wave incentive represented sharing rates of 25%-125% increments for shifts 1-5 respectively. Shifts 6 and 7 received no wave incentives and were paid only a fixed rate of \$4.40 per hour regardless of work output. The results showed three major trends: (i) shifts receiving wave incentives consistently performed above the standard rate whereas shifts receiving no incentive wage performed below standard, (ii) the general effect of the different sharing rates on productivity was irregular but the trend was toward higher productivity with higher sharing rate, (iii) higher productivity did not lead to lower work quality except for shift 5 which had the highest sharing rate (125%). The general conclusion from the study was that wage incentives are an effective means for improving productivity. Work is continuing on the analysis of certain psychological effects of wage incentives such as job satisfaction, job interest, and work strategies.

Research Colleagues at NPRDC: D. Nebeker and J. Riedel

1982

THE NPRDC MANAGEMENT INFORMATION SYSTEM

Crayton C. Walker

Department of Information Management
University of Connecticut
Storrs, Connecticut

ABSTRACT

An appraisal of the NPRDC Management Information System (MIS) was conducted and is reported in detail in the complete report including (i) a history and overview of NPRDC's MIS; (ii) positive and negative comments on interview data, (iii) an assessment of existing circumstances and evaluation and, finally (iv) a set of recommendations for NPRDC's MIS. The full report presents both the details and also an executive overview.

Research Colleague at NPRDC: R. Sorenson

1982

IX. ABSTRACTS OF PARTICIPANTS RESEARCH
at the
NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER
Annapolis and Carderock, Maryland

Program Coordinator at NSRDC: Elizabeth Cuthill

1982

APPROACHES TO DISTORTION ANALYSIS IN PROPELLER MANUFACTURE

Robert C. Creese

Department of Industrial Engineering
West Virginia University
Morgantown, West Virginia

ABSTRACT

Four major activities were performed in the analysis of the distortion which occurs during the casting of propellers. The solidification was analyzed by the modulus method to confirm that directional solidification was occurring and where shrinkage may occur. The thermal properties of various molding materials were collected and evaluated with respect to temperature and density. A mathematical thermal analysis of mold cooling was made to determine the importance of mold thermal properties upon the cooling rate. The production methods of propeller manufacture were analyzed to have a better understanding of the manufacturing steps involved and how these can be analyzed to determine where distortion occurs in manufacturing so it can then be controlled.

Research Colleagues at NSRDC: W. A. Palko and C. A. Zanis

1982

LITERATURE REVIEW FOR SHEAR LAG AND BUCKLING FAILURE IN SHIP STRUCTURES

Bruce K. Donaldson

Department of Aerospace Engineering
University of Maryland
College Park, Maryland

ABSTRACT

The technical literature was searched on two subjects: shear lag and buckling failure in ship structures. The common object was to discover information regarding design formulations. Ten articles on shear lag which are applicable to naval structures were studied in detail. These articles ranged from early formulations using plane stress analysis techniques (G. Winter, 1940) through later refinements (A. Mansour, 1970), to a summary article (D. Faulkner, 1975). According to these analyses, the shear lag effects are quite small for long equivalent beams fashioned from the effective portions of the adjoining plates plus the actual reinforcing stiffeners. For short equivalent beams, the application of beam theory is dubious in the first place. There are also questions that can be raised concerning the various selected boundary conditions. It would appear that the best design practice is to follow the simple empirical rules put forth by Faulkner.

The analytical treatment of the buckling behavior of structural elements and grillages is more complicated than the shear lag problem because this buckling problem is geometrically and materially nonlinear. In the case of naval structures, the analytical task is further complicated by the presence of residual stresses and initial out-of-plane displacements due to welding. Ten journal articles were located and reviewed. The identified analytical (as opposed to numerical) studies vary considerably in the complications admitted. Generally these studies are limited to only simple combinations of structural elements and do not address the problem of structures as complicated as a typical ship section. Thus it again becomes a matter of theoretically guided empiricism. The most extensive treatment of this approach that was found was a series of two articles principally by D. Faulkner in 1973 and 1975.

AUTOMATING A PLASMA FLAME SPRAY COATING SYSTEM
AT A NAVAL SHIPYARD

Robert M. Eastman

Department of Industrial Engineering
University of Missouri at Columbia
Columbia, Missouri

ABSTRACT

The research objective was to investigate the requirements for automating a plasma flame spray coating system and to make recommendations for a system to be installed at Naval shipyards. Plasma flame spray coatings make use of a high temperature plasma flame to atomize the coating material and impel it onto the work piece surface. Coating materials include metals, ceramics and combinations. Naval shipyards use flame spray coatings to rebuild worn parts (ex. steam valve stems), to apply corrosion-resistant and non-skid coatings and for other special applications. Plasma flame is required to get the high temperatures necessary to atomize some materials such as ceramics and tungsten. The recommended system automates the coating process including gun ignition and movement, work piece movement and the gas, power and material inputs. This automation improves quality and productivity while reducing cost. A robot can be used for gun and work piece manipulation. Future research and development needs include (1) numerical and programming methods to simplify computer control for small lots (often a single part) (2) automation of work piece handling (3) direct in-process measurement and control (4) robotics (5) improved coating materials and technology and (6) life-cycle integration and group technology. The research found that automating the thermal spray coating process can be quantity and quality productive and cost effective in Naval shipyards. Much more research and development is needed to prove the system even further.

Research Colleague at NSRDC: A. Pollack

1982

STRESS AND IMPACT ANALYSIS OF COMPOSITE MARINE
PROPULSION SHAFTING

Francis T. C. Loo

Department of Mechanical and Industrial Engineering
Clarkson College of Technology
Potsdam, New York

ABSTRACT

It is a well known fact that the advantages of using fiber reinforced composite material for shafting in place of metal, such as steel and bronze, are weight saving, high corrosion resistance, better fatigue strength, high impact and shock resistance, low thermal and electric conductivities, and material is not prone to brittle fracture.

A composite materials investigation directed toward marine shafting applications is underway at NSRDC-Annapolis. Designs and experiments have been developed to investigate strength, fatigue strength in seawater, coupling techniques and in comparison with the existing marine shafting. A trial is scheduled on a patrol ship (YP Class) in the near future.

The present study considered impact and shock stresses as part of the overall program to evaluate composite material for marine propulsion shafting. The basic conclusion reached was that a properly designed composite shaft should not suffer from stress or impact problems beyond the existing practice.

Additional future research investigation, such as fracture behavior of composite materials, fatigue life prediction, etc. are recommended.

Research Colleague at NSRDC: J. Spargo

1982

AD-A159 782

NAVY-ASEE (AMERICAN SOCIETY FOR ENGINEERING EDUCATION)
SUMMER FACULTY RES. (U) OFFICE OF NAVAL RESEARCH BOSTON
MASS R L STERNBERG 1982

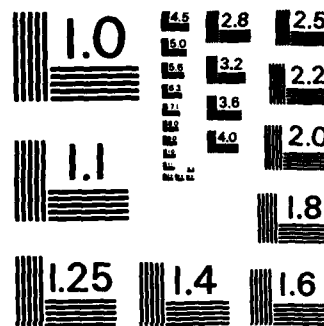
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

MIXED LUBRICATION IN BEARINGS AND SEALS

A. Kent Stiffler

Department of Mechanical Engineering
Mississippi State University
Mississippi State, Mississippi

ABSTRACT

Low speed, start-stop operation of thrust and journal bearings results in a state of high friction, wear, and vibration between the sliding surfaces, called mixed lubrication. The breakdown of the hydrodynamic full fluid film support is caused by the interaction of surfaces' roughness. Most face seals operate in this regime, leakage being the predominant concern.

Mixed lubrication is identified with the transfer of load support from the whole surface to the asperities (roughness peaks). Several stages of asperity interaction are proposed with successively higher transfer of load support and correspondingly smaller fluid films between asperities: (1) hydrodynamics at the asperity level; (2) elastic deformation of the asperity which alters the fluid film shape; (3) local heating which destroys the fluid film and causes dry contact.

The statistical theory of surface roughness is reviewed. The governing equations of fluid mechanics, energy, and elasticity are outlined. The non-Newtonian behavior of the fluid is related to pressures, temperatures, and strain rates. Various asperity models are reviewed. Thus, the foundation is given to find the friction forces in the mixed lubrication regime as a function of fluid properties, surface roughness, and surface mechanical properties. A major result is expected to be the conditions for thermal breakdown of the local film which leads to accelerated wear. These concepts are essential to the face seal wear and leakage problem.

X. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL SURFACE WEAPONS CENTER

Silver Spring, Maryland

and

Dahlgren, Virginia

Program Coordinator at NSWC: Wendell Anderson

1982

THE CALCULATION OF NUCLEAR WEAPONS EFFECTS AT HIGH ALTITUDES

John G. Eo11

Department of Physics and Astronomy
Lenoir-Rhyne College
Hickory, North Carolina

ABSTRACT

Work described in a previous report ("A Computer Program for the Evaluation of Nuclear Weapons Effects," NSWC-WOL-TR-81-415, 8 October 1981) has been continued and expanded. In addition to the calculation of gamma and neutron doses, three new effects have now been added: peak overpressure (shock pressure), X-ray fluence, and thermal fluence (radiant heat). Also, the calculations of gamma and neutron doses have been expanded to include neutron fluence of 14 MeV Silicon-equivalent neutrons, neutron fluence in terms of the heating of fissionable material, and a more careful treatment of hydro-dynamic attenuation in the determination of gamma dose. Once again the methods originally developed by the Naval Radiological Defense Laboratory (NRDL) have been employed wherever possible. In the case of the nuclear radiations (gamma and neutron fluence) the method of calculation is based upon the use of an exponential attenuation factor multiplied by a buildup factor to account for the scattering of the radiation by air. The calculation of shock pressure is based upon a numerical approximation to the classical Sedov-Taylor blast wave solution developed by J. F. Moulton. The thermal energy and X-ray calculations are based upon interpolating schemes obtained by Alexander and Schnider. These methods have been improved through the use of a new model atmosphere approximation and more up-to-date emission rate data. Verification of the accuracy of the results was obtained by comparison to the considerably more detailed Monte Carlo calculations done by the Los Alamos National Laboratory for the W-82 warhead.

Research Colleague at NSWC: F Warnock

1982

PACKETS AND INTERRUPTS OF THE LOCAL AREA NETWORK

Thelma W. Hedgepeth

Department of Mathematics
Virginia Union University
Richmond, Virginia

ABSTRACT

My research at NSWC/Dahlgren involved packet switching and the interrupt system of the Local Area Network (LAN). Local Net is a packet switched local area data communications network providing communication functions via a broadband CATV data distribution system. Packet switching involves short messages (packets) which are handled individually by the Local Net mechanism.

In an interrupt system, an interrupt request interrupts the computer program on completion of the current instruction. Processor hardware then causes a subroutine jump. (a) Contents of the program counter and other processor registers are automatically saved in specific memory locations. (b) The program counter is reset to start a new instruction sequence from a specific memory location associated with the interrupt. The interrupt acted upon is disabled. The interrupt routine ends by restoring the registers and program counter to return to the original program. This routine must also reenale the interrupt.

Prior to data collection of interrupts and packets on the cable, several problems had to be solved with respect to the PDP 11/03 computer, PDP 11/40 computer and the CDC 6700 computer. First, familiarity with operational literature for the computers was necessary for data transferal.

Research Colleagues at NSWC: E. Stemple, R. Sparbel, and J. Sanchez 1982

A THEORETICAL INVESTIGATION OF THE POTENTIAL
ENERGY HYPERSURFACE OF $(\text{CH}_3\text{NO}_2)_n$

Walter H. Jones

Department of Chemistry
University of West Florida
Pensacola, Florida

ABSTRACT

The objective of the research was to understand the relationship of molecular structure to shock sensitivity, in order to facilitate synthesis of high energy materials with good handling characteristics. The general approach taken was to conduct theoretical analysis of chemical reactions under detonation conditions, which are not readily accessible experimentally, and to define critical experiments to test the theory under the basic assumption that the activation energy for initiation of an explosive is reduced at high pressures in two ways: rupture of bonds which are weakened by coupling of electronic ground and excited states; and rupture by reactions among intermolecular atoms. More specifically, the approach taken was to extend prior studies of $(\text{NO})_n$ to $(\text{CH}_3\text{NO}_2)_n$, and transfer the findings to larger molecules. In carrying out the details the best currently available semi-empirical molecular orbital program was obtained, installed on the local computer, and tested on known explosive molecules. The potential energy surface of $(\text{CH}_3\text{NO}_2)_n$ ($n=1,2,3$) was then investigated, starting with the recently reported³ geometry of crystalline nitromethane. Three local minima were found for $(\text{CH}_3\text{NO}_2)_n(g)$, one of a configuration like the two nearest neighbors in the crystal, one corresponding to a linear dimer, and a third - of lowest energy - corresponding to a parallel dimer. The linear and parallel trimers were also investigated. Zero degree isotherms were constructed from the variation of energy with intermolecular separation. In conclusion, it was found that the $(\text{CH}_3\text{NO}_2)_n$ hypersurface is quite flat, the lower energy intermolecular separations² hovering near the separations in the crystal. In addition, no evidence of strong hydrogen bonding was found. Finally, it was determined that at pressures $P > 10$ kbar, the linear dimer is preferred to the parallel dimer, which is the more stable species at low pressures.

USE OF PERMANENT MAGNETS FOR BIAS FLUX PROVISIONS IN TERFENOL RODS

Samuel Noodleman

Department of Electrical Engineering
University of Arizona
Tucson, Arizona

ABSTRACT

The purpose of this summer research program was initially to determine if permanent magnets could be satisfactorily used to provide bias flux in Terfenol rods. Experimental transducers producing acoustic power have been developed using 1/4 inch diameter, 2 inch long Terfenol D rods. During the analysis of the various components making up this type transducer, a study was made of the excitation coil and the factors effecting its design and operation. Equations were developed relating to specific coil configurations providing methods of calculating coil resistance and the effects of coil diameter with respect to coil length on the magnetic field intensity developed in the center of the coil.

Numerous tests were made with a magnetic fixture using Terfenol rods in energized coils, with permanent magnets, and with both forms of magnetic excitation. These tests indicated the optimum magnet location and the size and shape of the magnet necessary to provide the required fields in the Terfenol rods. They also provided the information of the best ferromagnetic material and its construction for completing the magnetic circuit between the Terfenol rods. The performance and characteristics of the present transducer was also analyzed. Since this device takes in electrical energy and converts it into mechanical motion, it can be considered similar to an electric motor. Using this concept, circuits, schematic function, and equations were developed to calculate the performance of the device. During the testing and studies of the various magnetic configurations, it was suggested that a better method was needed for determining the magnetic field intensity H across the rod. Tests using a Hall Probe with its associated incremental Gaussmeter did not provide accurate information regarding this parameter.

In order to obtain suitable performance from the transducer, the Terfenol material must be at high compression which causes its relative permeability to be about five or lower. This is a very low permeability for magnetic material. The present rod diameter is not compatible with the amount of excitation needed to control it with conventional cooling for the excitation coil. A rod one inch in diameter would develop forces sixteen times that of a 1/4 inch diameter rod. However, for a given length the same amount of magnets motive force can drive the required flux through the 1 inch diameter rod as is needed for the 1/4 inch diameter rod. The losses of the excitation coil would be increased somewhat because of the larger I.D. but not nearly as much as the increase in force. Also the larger coil can dissipate more heat as its surface area and heat capacity have increased. Thus increasing the rod area in relation to its length makes it more compatible with the coil required to provide its excitation and permanent magnets when needed to provide a bias flux for its operation.

Research Colleague at NSWC: A. Clark

1983

APPROXIMATION OF DEPOSITION PROBABILITIES

Andrew M. Olson

Department of Mathematics
University of Puerto Rico
Rio Piedras, Puerto Rico

ABSTRACT

A method was developed by which it is possible to approximate efficiently the probability that two objects in a field of objects subject to random deposition errors will fall within a specified distance of each other. It is assumed that the field is constructed by depositing the objects along a collection of lines by means of a process subject to random, normally distributed errors.

Algorithms were developed that can be implemented on a computer. When completed, these codes will provide an efficient and accurate method for studying different deposition strategies as a function of deposition density, line dispersion, line orientation, and deposition uncertainty. The algorithms could also be incorporated into the computer codes used for developing actual field layouts, providing in this manner a realistic safeguard against close deposition and a probabilistic measure of each layout.

ANALYSIS OF A SOFTWARE IMPLEMENTATION FOR
A TRUE POINT SOURCE DETECTOR

Osborne C. Parchment

Department of Mathematics and Computer Science
Morgan State University
Baltimore, Maryland

ABSTRACT

The development of automatic detection systems to identify targets against varying sky backgrounds is an important element in the defense of both surface and airborne naval platforms. Infrared Search and Track (IRST) systems are designed to detect target signatures by analysis of spatial and temporal variations in the infrared radiance from an engagement scene. This report examines a proposed implementation of an Adaptive Threshold True Point Source (AT TPS) spatial filter described by R. L. Sternberg in the software of the IRST simulation outlined by S. Petropoulos and currently running at the Naval Surface Weapons Center. The intent is to determine whether changes in simulation outputs are induced by using an AT TPS filter in series or in parallel with the spatial filter programmed into the simulation. A program module to implement the AT TPS filter is included; actual testing requires input data of a particular type.

Research Colleagues at NSWC: A. Hirshman and S. Petropoulos

1982

CASTING ALUMINUM-LITHIUM ALLOYS

T. H. Sanders, Jr.

School of Materials Engineering
Purdue University
Lafayette, Indiana

ABSTRACT

A series of Aluminum-Lithium-Copper-Magnesium alloys were cast and extruded into rectangular sections (1 1/4" x 3/8"). The aluminum base alloys had compositions (in weight percent) in the range Li: 0.5 - 3.0%, Cu: 0.5 - 4.5%, Mg: 0.0 - 3.5%. The compositions were chosen such that each alloy could be solution heat treated into the single phase field.

The alloys were cast in a glove box containing circulated and scrubbed helium. Oxygen, nitrogen, and water levels were each monitored and maintained at values less than 1ppm.

The various alloys were melted and poured into a brass mold with a hot top to minimize the pipe in the ingot. The alloys were homogenized for 12 hours at 400°C in an air circulating furnace. Each alloy was then machined into a cylinder 2 7/8" diameter x 4 1/4" long. These billets were hot extruded into rectangular sections.

Results of tensile and fatigue crack growth tests on various specimens will be reported after completion of the project.

XI. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL UNDERWATER SYSTEMS CENTER

Newport, Rhode Island

and

New London, Connecticut

Program Coordinator at NUSC: Paul Scully - Power

1982

IMPROVEMENT OF A HIGH SPEED OTDR FOR
EVALUATING FIBER OPTIC LINKS

Allen D. Drake

Department of Electrical Engineering and Computer Science
University of Connecticut
Storrs, Connecticut

ABSTRACT

Ten task items were identified at the start of the research with the objective of improving the resolution of a high speed OTDR (optical time domain reflectometer). These tasks included employing higher speed techniques, improving linearity, reducing the system's noise, and installing a different style coupler. Their purpose was to obtain better attenuation measurements and better quantification of coupler, hull penetrator, and hydrostatic pressure losses over short lengths of fiber.

A faster APD (avalanche photodiode) circuit was used, which gave a pulse width of 3 ns, and this was deemed sufficient. It was found that for sufficient gain with the present equipment, especially on the receiving end of the OTDR, good linearity was impossible, so other equipment was ordered and modifications were specified on present equipment. System noise was reduced a small amount by careful adjustment, but significant improvement will have to await the arrival of better equipment. Optical design work was carried out for installing the different style coupler, but after installation, the new coupler was found to be worse than the original.

Thus the goals of the project were partially met, and several pieces of equipment were identified and ordered, which will without a doubt improve the OTDR's usefulness substantially in the future. Present Navy personnel were briefed on the goals and means of this project so that they will be able to continue the experimentation and perform the appropriate testing when the ordered equipment arrives.

NUMERICAL SOLUTIONS OF THREE DIMENSIONAL PARABOLIC
EQUATIONS AS APPLIED TO UNDERWATER ACOUSTICS
IN REALISTIC OCEAN ENVIRONMENTS

Gregory A. Kriegsmann

Department of Engineering Sciences and Applied Mathematics
Northwestern University
Evanston, Illinois

ABSTRACT

During the program Ding Lee and the writer have been developing a three dimensional finite difference code to solve practical underwater acoustic propagation problems of interest to the Navy. The program will quantitatively describe the effects of mesoscale oceanic inhomogeneities on the propagation of sound. To this end, we have recently developed an alternating direction scheme to solve the parabolic wave equation which governs acoustic propagation in the ocean. This scheme is very accurate and stable. It also faithfully conserves or dissipates energy according to the continuous problem. In conjunction with this scheme we have invented an explicit algorithm for inverting large almost tridiagonal matrices. We have also spent a good deal of time learning about mesoscale oceanic fronts and eddies. These effects profoundly influence sound propagation. Their accurate mathematical description is a necessary input to our computer code.

In addition to this work the writer was able to develop a new rational and systematic way of deriving the parabolic approximation to the acoustic wave equation which yields the parabolic equation mentioned above. This derivation uses the notions of matched asymptotics and multiple scales which bear out the structure of the acoustic field and is expected to be useful in reducing the number of difference equations which have to be solved in typical applications.

Research Colleague at NUSC: D. Lee

1982

XIII. CUMULATIVE COMPILATION OF DATA ON LATER RESEARCH FALLOUTS FROM THE 1979, 1980 AND 1981 PROGRAMS

Plan and Procedure

As noted in the Introduction and Executive Summary an important part of the objectives of the NSFRP program has been to develop continuing research of Navy interest at the participating faculty members colleges and universities and to establish continuing technical relations among college and university faculty members and their professional scientific and engineering peers in the Navy laboratories.

In an effort to determine to what extent the NSFRP programs have been successful in this regard, plans for tracking the Navy related activities and research of former NSFRP participants were established in 1981 and beginning with the 1981 report the NSFRP participants and the Navy laboratory Program Coordinators from the 1979 and 1980 programs were polled to determine what Navy related technical activities of the NSFRP participants took place subsequent to their summer's experience at the Navy laboratories which were brought about, stimulated by, or otherwise made possible, as a result of their experience under the NSFRP programs. This policy has been continued in the preparation of this report and the NSFRP participants and Navy laboratory Program Coordinators from the two programs previously polled were again queried and the NSFRP people from the 1981 program were similarly polled as to their subsequent Navy related technical activities.

Significant highlights of these "research fallout" as we term them are summarized below for the 1979, 1980 and 1981 programs and in future years similar fallouts from the 1982 and later NSFRP programs will be tracked -- for inclusion in future reports -- along with any new fallouts from the 1979, 1980 and 1981 programs as they occur.

Research Fallouts and Activities

The types of research fallouts from the NSFRP programs which have thus far been identified fall more or less into three categories which we may describe as: (i) research contracts, (ii) research papers and (iii) later Navy employment or other working relationships which have developed between former NSFRP participants and the Navy laboratories.

Among the research fallouts from the 1979 NSFRP program we may note the following items of interest:

- o 8 Research contracts totalling about 184,000 dollars have been awarded to five former 1979 NSFRP fellows as a result of the program;

XIII. CUMULATIVE COMPILATION OF DATA ON
LATER RESEARCH FALLOUTS
FROM THE 1979, 1980 AND 1981
PROGRAMS

NEW CHEMISTRY FROM THE REACTION OF N,N'-DISUBSTITUTED
ETHYLENEDIAMINES WITH GLYOXAL SYNTHESIS OF 2-FORMYL-
1,3-DIAZACYCLOPENTANES AND 1,4,5,8-TETRAAZA-9,10-
DIOXAPERHYDROANTHRACENES

David J. Vanderah

Department of Chemistry
Chatham College
PITTSBURGH, PENNSYLVANIA

ABSTRACT

Reaction of equivalent amounts of N,N'-disubstituted ethylenediamines and glyoxal under very mild conditions produced low but significant yields- ~5 - 23%- the novel 1,4,5,8-tetraalkyl-1,4,5,8-tetraaza-9,10-dioxaperhydroanthracenes when $R = CH_3$ -, OCH_2 -, $(CH_3)_3C$ - along with, in larger amounts, the known 2-piperidone compounds. Complete nmr analysis of the former compounds coupled with computer simulation programs allows the tentative assignment of cis-anti-cis stereochemistry for all four compounds. Surprisingly, when N,N'-diphenylethylenediamine was reacted with glyoxal under similar conditions, a high yield of 2-formyl-1,3-imidazolidine was obtained. This monofunctionalized glyoxal derivative showed stability when exposed to moderate temperatures, $\sim 110^\circ C$, and under acidic conditions. The later compound has significant potential as a useful C_2 synthon.

Research Colleagues at NWC: R. Willer and R. Atkins

1982

LASER SITE SELECTIVE SPECTROSCOPY OF $\text{Eu}(\text{TERPY})_3^{3+}$

James P. Riehl

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University of Missouri at St. Louis
St. Louis, Missouri

ABSTRACT

High resolution emission spectra from $\text{Eu}(\text{terpyridine} \equiv \text{terpy})_3^{3+}$ were measured and analyzed in order to study the solid and solution structure of this species. A pulsed tunable dye laser was employed as the excitation source. It was possible to selectively excite Eu_3^{3+} ions in various chemical environments. The emission spectra can then be used to estimate relative concentrations of the various species. It is anticipated that these types of studies will lead to information concerning the structural changes that these species $\text{Eu}(\text{terpy})_3^{3+}$ undergo when bound to solid surfaces. Preliminary experiments on $\text{Eu}(\text{terpy})_3^{3+}$ on MgO were also undertaken.

Research Colleague at NWC: R. Schwartz

1982

MODULATION OF LANTHANIDE OPTICAL PROPERTIES BY LIGANDS
AND BY SOLVENT OR CRYSTALLINE MEDIA

Frederick S. Richardson

Department of Chemistry
University of Virginia
Charlottesville, Virginia

ABSTRACT

An analysis of lanthanide optical properties and their modulation by ligand or matrix environments was carried out. Both theoretical and experimental factors were included in this analysis, and special emphasis was placed on the systematics involved in choosing and preparing lanthanide-based systems to be used in fabricating optical materials for specific applications of interest to the Navy. The general principles evolving from this analysis were applied to two specific problems being actively worked on by personnel at the Naval Weapons Center. Full details are available in the complete report being published at NWC.

Research Colleague at NWC: R. Schwartz

1982

SAMPLE PREPARATION AND MICROWAVE CHARACTERIZATION
OF ARTIFICIAL DIELECTRICS AND MAGNETIC ABSORBERS

Raghvendra K. Pandey

Department of Electrical Engineering
Texas A&M University
College Station, Texas

ABSTRACT

Samples of artificial dielectrics and magnetic absorbers were made for microwave applications between 4 to 16 GHz. A substantial portion of time was also spent in interacting with the personnel of Naval Weapons Center who are involved in crystal growth of Tourmaline and device fabrication of GaInP semi-conducting material. A thorough literature search was done on the following topics: (i) artificial dielectrics, (ii) magnetic absorbers, (iii) magnetically ordered ferroelectrics, (iv) characterization of nonlinear dielectric and magnetic materials at microwave frequencies, and (v) single crystal growth of Tourmaline and compound semi-conductors. It is anticipated that the work will continue in two or three research programs to be jointly undertaken by the Materials Research Group at Texas A&M University and the Physics Department of Naval Weapons Center.

Research Colleagues at NWC: D. White, R. Dinger and R. King

1982

PERIODIC AND CHAOTIC BEHAVIOUR IN DISCRETE AND CONTINUOUS
DYNAMIC SYSTEMS

Tyre A. Newton

Department of Pure and Applied Mathematics
Washington State University
Pullman, Washington

ABSTRACT

A study was made of periodic and chaotic behaviour in both discrete and continuous dynamic systems. This study was motivated by attempting to better understand a four dimensional differential system with coulomb damping encountered by the participant in 1974 while on sabbatical leave at NWC, and a double strange attractor developed and reported in a joint paper with R. B. Leipnik in Phys. Lett. A, 86 (1981), 63-67. Chaotic motion, usually the result of a strange attractor, is found in such physical situations as turbulence in fluids, chemically reacting systems, plasmas, solid state physics, and lasers, to name a few. A major tool to date in the study of strange attractors has been to interpret them in terms of one-dimensional, discrete dynamical systems. Two-dimensional discrete systems, such as the Henon Map, are now getting much attention. (For a survey of work to date, see Ott, E., Rev. Mod. Phys., 53 (1981), 655-671). In particular, this study will be continued for higher dimensions such as the four-dimensional system mentioned above, and systems for which the divergence of the phase-space flow is not a negative constant (e.g. the Oregonator, a continuous model of the Belousov-Zhabotinsky chemical reaction system) as has usually been the case with such systems when considered so far.

Research Colleague at NWC: D. Gillespie

1983

NWC CRYOGENIC EMISSOMETER -- INITIAL PERFORMANCE

Lawrence H. Johnston

Department of Physics
University of Idaho
Moscow, Idaho

ABSTRACT

Initial performance is reported for a cryogenic thermal emission spectrophotometer which has been rebuilt and adapted to the sample configuration requirements of this Laboratory. A wavelength range of 2.5 to 14.5 micrometers is covered, using a circular variable interference filter as the selective element. Sample temperatures can be varied from 90 to 600K. The optics are kept at 90K to minimize background radiation from them. Initial emission spectra are shown for two samples: first, Tantalum, and second, a multilayerdielectric mirror designed for maximum reflectance at 10.6 μm . It is estimated that an emittance of 0.005 (1.0 = blackbody) can be detected at present, for opaque samples.

Research Colleague at NWC: H. Bennett

1982

XII. ABSTRACTS OF PARTICIPANTS RESEARCH

at the

NAVAL WEAPONS CENTER

China Lake, California

Program Coordinator at NWC: Dick Wisdom

1982

REDESIGN OF AIR-RUBBER BAFFLE TILES FOR
SHOCK RESISTANCE

Frank E. Weisgerber

Department of Civil and Environmental Engineering
University of Cincinnati
Cincinnati, Ohio

ABSTRACT

Air-rubber baffle tiles are used to help shield externally mounted sonar arrays from self noise on submarines. The original tile design, composed of rubber and polyvinyl chloride in a multi-layered sandwich configuration, was found by others to be deficient in resistance to underwater explosions. The goal of the assigned task was to devise a modified design which would meet at least the minimum requirements on shock resistance while it maintained the acoustic, strength and stiffness properties of the original design. Several possible modifications were considered and models of the three most promising were designed and are to be evaluated by testing at the lab.

Research Colleague at NUSC: None

1982

MATHEMATICAL STUDIES OF LENSE AND FILTER PLATE
PROBLEMS IN ACOUSTICS

Murray Wachman

Department of Mathematics
University of Connecticut
Storrs, Connecticut

ABSTRACT

The uniqueness problem for a nonspherical bi-focal elliptized symmetric acoustic lense was examined and a plausibility argument tending to show that the solutions are not unique was presented but without a rigorous proof. The question of the existence of solutions was also studied but except for deriving some properties which might later help in a full proof no real progress was made on the existence problem. However, a new numerical algorithm for construction of a set of points defining a required nonspherical symmetric acoustic lense was prepared and was later programmed at NUSC. Work was started on the acoustic filter plate vibrational analysis problem in support of earlier work by A. J. Kalinowski at NUSC. It is anticipated that this work on the filter plate will continue in a collaborative effort by Kalinowski and the author of this abstract at the conclusion of which comparisons will be made of the new results with previously computed finite element solutions of the problem.

Research Colleagues at NUSC: R. L. Sternberg and A. J. Kalinowski 1982

AN INVESTIGATION OF AgO DISCHARGE IN KOH AND LiOH

Robert E. Seevers

Department of Chemistry
Southern Oregon State College
Ashland, Oregon

ABSTRACT

Samples of AgO were discharged in LiOH and KOH using zinc as the anode. Current density, electrolyte flow rate, and electrolyte concentration were varied in order to determine the extent to which the cathode capacity and voltage decay were affected. Experimental results indicate that the capacity was not affected by variations in these quantities and was independent of the choice of electrolyte. The cathode voltage exhibited gradual decay in both electrolytes that increased with decreases in concentration and increases in current density, but showed little dependence on the electrolyte flow rate. This decay was attributed to polarization resulting from an increase in electrolyte resistance with a decrease in concentration and to an increase in the internal IR drop associated with an increase in current density.

Variations from sample to sample were found in the AgO capacity. This was attributed to similar variations in the AgO content. By further anodizing samples before discharging, it was possible to increase capacity to near the theoretical maximum.

AN ANALYSIS OF SPACE SHUTTLE IMAGING RADAR (SIR-A)
OF THE COASTS AND OCEANS

Aulis Lind

Department of Geography
University of Vermont
Burlington, Vermont

ABSTRACT

Several oceanic/coastal study areas were selected under the orbital path of the Space Shuttle-2 mission synthetic aperture L band imaging radar, representing a range of environments in virtually all of the major oceanic regions. These include the Bay of Bengal, the Arabian Sea, the Red Sea, the Atlantic Ocean near Cape Hatteras, the Gulf of Mexico, the Gulf of Tonkin, and the Mediterranean Sea.

There exists ample documentation showing the close relationship between radar backscatter and wind conditions; however, most cases studied are limited in extent and do not represent a variety of situations where radar look angles vary in relationship to the mean wind field. The new experiment departs from previous investigations on the subject since macro-densitometry is used in the spot (2 mm.) mode using a synthetic 4 nautical mile sampling rate. Previous studies (i.e. Beal *et. al.*, 1981) include mainly micro-densitometric traces employing spot size sampling of less than 0.5 mm. Study areas were sampled in the near, middle, and far range of the 5 inch optically processed film, thus producing three sets of data strings measuring image density. Wind data for each area were provided from U.S. Navy fleet meteorological sources and were computer processed and used in standard wind rose format.

The results of the analysis show a set of consistent relationships between image density and wind field characteristics under the variety of conditions explored; which include varying depth, wind exposure (leeward effects) and varying direction relative to the radar footprint. A preliminary model is proposed relating the radar return, expressed as image density and wind field characteristics. Additional features of the scenes, include such features as wave patterns, windows and "slicks."

The Space Shuttle SAR, (SIR-A) though originally intended for terrestrial remote sensing purposes appears to have considerable potential for oceanographic work as well. Further experimentation and study seem justified.

Research Colleagues at NUSC: P. Scully-Power and J. Malay

1982

ANALYSIS OF THE ACOUSTIC AND MECHANICAL COMPONENTS
OF NOISE COUPLED INTO TORPEDO SONAR ARRAYS

Lester R. LeBlanc

Department of Ocean Engineering
University of Rhode Island
Kingston, Rhode Island

ABSTRACT

The purpose of this research was to investigate the feasibility of using new methods of signal processing analysis for studying the sources of noise coupled into torpedo sonar arrays. Analog recorded time series data from a unique experiment was available to use in the testing of these methods. The experiment involved the analog recording of six adjacent sonar array elements (2 x 3 configuration) at high, medium, and low speed torpedo runs. These three speed runs provided a wide diversity in the blend of hydroacoustic, mechanical, and ambient noise. A General Radio Time Series Language computer was used to calculate the components of the cross spectral density matrix by using a repetitive analysis method which used two array elements at a time. To insure exact time sync, a time code reader was configured to trigger the A/D conversion process.

The resulting cross spectral density files were then transferred to the VAX computer system for further analysis and display. A highly efficient algorithm for accomplishing wave vector filtering and principal component (PC) analysis was developed for processing the sonar array data. The PC method of analysis is used to separate the cross spectral density matrix into a group of statistically independent cross spectral density matrices.

The resultant group of new matrices are then analyzed by conventional sonar plane wave interpretative methods such as wave vector filtering and beam-forming analysis. This unique combination of signal processing provides a complete wave directional and frequency dependent view of the separable independent source of noise arising out of the various speed runs of the torpedo. This new aspect of the work is not completed yet, but is being further pursued at NUSC. At present, the cross spectral density matrix results have provided interesting results when comparing high speed to the low speed performance of the sonar array.

- o 7 Papers have been given as invited addressees or have been published in refereed journals and several more are still planned or are in preparation as a result of work started under the 1979 program;
- o 2 Former 1979 NSFRP fellows have held Navy intergovernmental personnel act appointments at NRL and NSRDC in subsequent summers or on a continuing one-day-a-week basis;
- o 1 Former 1979 NSFRP fellow has been employed as an intermittent Navy civil servant on a continuing one-day-a-week basis at NRL since completion of his summer appointment;
- o 1 Former 1979 NSFRP fellow based his doctoral dissertation on work started under the program and completed his thesis and PhD while supported by follow-on Navy contracts resulting from the program;
- o 1 Former 1979 NSFRP fellow has become a full time Navy civil servant at NSWC.

And from the 1980 NSFRP program we may note also the following fallouts:

- o 4 Research contracts totalling about 106,000 dollars have been awarded to four former 1980 NSFRP fellows as a result of the program;
- o 7 Papers have been presented as invited addressees or have been submitted or accepted by refereed journals, and others are still planned or in preparation as a result of work started under the 1980 program;
- o 1 Former 1980 NSFRP fellow has subsequently been employed as a summer temporary Navy civil servant at NUSC following his initial summer in the program;
- o 1 Former 1980 NSFRP fellow has subsequently been employed on a continuing one-day-a-week basis as a temporary Navy civil servant at NSWC since completion of his summer appointment.

And from the 1981 NSFRP program we may note similarly the following fallouts:

- o 30 Papers have been presented as invited addresses or have been submitted or accepted by refereed journals, and others are still planned or in preparation as a result of work started under the 1981 program;
- o 1 Former 1981 NSFRP fellow has subsequently become a Navy civil servant at NRL following his initial summer in the program and at least two others are in the process of planning IPA appointments at NRL and NCSC for their coming sabbatical years' leave from their respective universities;
- o 2 Former 1981 NSFRP fellows have subsequently been employed on a continuing one-day-a-week or other basis as consultants at NRL and NSWC.

Further specifics about the research contracts awarded as follows from the 1979, 1980 and 1981 NSFRP programs are listed in Tables IV, V and VI along with the names of the 1979, 1980 and 1981 NSFRP contract winning participants, their college or university affiliations and the Navy laboratories with which they had been associated under the NSFRP programs for those three years.

Table IV

RESEARCH CONTRACTS AWARDED TO FORMER NSFRP PARTICIPANTS IN THE 1979 PROGRAM WITH
FUNDING IN THOUSANDS OF DOLLARS

<u>Participant</u>	<u>Academic Department</u>	<u>College/ University</u>	<u>Contract No.</u>	<u>Funding</u>	<u>Laboratory</u>
Bowman, T.T.	Mathematics	U Florida	N00167-79-M-4321	10	NSRDC
Cramer, M.S.	Eng Sci & Mech	VPI	N00173-80-M-7172	10	NRL
			N00014-81-C-2286	3	
			N00014-81-C-2314	14	
Pollack, G.L.	Physics	Michigan State	N00014-80-C-0617	82	NMRI
Vawter, D.L.	Eng Sci & Mech	VPI	N00014-81-K-0126	45	NMRI
Young, C.T.	Mech Engineering	OK State	N00167-80-M-0333	10	NSRDC
			N00167-81-M-6260	10	

Total funding for 1979 research contract fallouts in thousands of dollars-----184

Table V
RESEARCH CONTRACTS AWARDED TO FORMER NSFRP PARTICIPANTS IN THE 1980 PROGRAM WITH
FUNDING IN THOUSANDS OF DOLLARS

<u>Participant</u>	<u>Academic Department</u>	<u>College/ University</u>	<u>Contract No.</u>	<u>Funding</u>	<u>Laboratory</u>
Busby, H.R.	Mech Engineering	N D State	N00140-81-M-DZ14	5	NUSC
Dube, R.L.	Elect Engineering	W New England	N00140-81-M-FZ73	10	NUSC
Gilmore, C.M.	Engineering	GWU	N00019-80-C-0403	56	NRL
Johnson, D.H.	Elect Engineering	Rice U	N00014-81-K-0565	35	NOSC

Total funding for 1980 research contract fallouts in thousands of dollars----106

Table VI

RESEARCH CONTRACTS AWARDED TO FORMER NSFRP PARTICIPANTS IN THE 1981 PROGRAM WITH
FUNDING IN THOUSANDS OF DOLLARS

<u>Participant</u>	<u>Academic Department</u>	<u>College/ University</u>	<u>Contract No.</u>	<u>Funding</u>	<u>Laboratory</u>
Johnston, L.H.	Physics	U. Idaho	N60530-82-W-G71	3	NWC
Kolata, P.R.	Elect Eng & Comp Sci	Drexel	N62269-82-C-0431	20	NADC
LeBlanc, L.R.	Ocean Eng	URI	N00140-82-M-UZ44	10	NUSC
MacIntyre, F.	Oceanography	URI	N00140-82-M-PJ78	8	NUSC
McLauchlon, R.A.	Mech Eng	Texas Tech	N66001-82-R-190GP	33	NUSC
Marchand, A.P.	Chemistry	U. Okla	N00014-82-K-2019	25	NWC
Mikesell, R.P.	Mech Eng	S. Dakota	N00014-82-K-2035	5	NRL
Shelton, W.W.	Elec Eng & Comp	F1 In Tech	N60921-82-M-1668	10	NSWC
Vietti, M.A.	Physics	U. Maine	N00173-PR-43-2090	10	NRL

Total funding for 1981 research contract fallouts in thousands of dollars-----124

Recalling that the 1979 NSFRP program involved only 16 participants while the 1980 program supported only 26 and the 1981 program involved only 59 it follows from the data presented in the foregoing, that a substantial fraction of the first three years participants had some subsequent technical relation with the Navy as a result of the 1979, 1980 and 1981 programs. Thus, lumping the three programs together, 18 out of 101 participants in 1979, 1980 and 1981 had follow-on contracts with the Navy while 8 others subsequently held, or at the time of writing this report expected shortly to hold, intergovernmental personnel act appointments or temporary civil service appointments with the Navy and at least two former participants became full time civil servants and Navy scientists.

No attempt has yet been made to track the research fallouts from the 1982 NSFRP program, it being judged too early yet for a reasonably full list of such fallouts to be practical to compile. As noted above, however, fallouts from the 1982 program and from NSFRP programs of future years as well as any new fallouts that may yet develop from the 1979, 1980 and 1981 programs will be tracked in the years to come as they occur and will be documented in future reports.

XIV. OUTLINE OF PLANS
FOR THE FUTURE

XIV. OUTLINE OF PLANS FOR THE FUTURE

Plans for 1983

As presently planned the 1983 NSFRP program will bring about 100 faculty members to the 10 participating Navy laboratories with somewhat less than half of them supported by ONR. No new Navy laboratories will be added to the program in 1983 but the Navy laboratory support for the program is anticipated to increase in accordance with these estimates.

For the 1983 program, the participants will be paid 6000 dollars each, which represents about a 19 percent increase over the 1982 stipends of 5500 dollars per participant.

The academic pool of applicants from which the 1983 program participants will be selected appears also to be broadening with more scientists having applied to the 1983 program from the larger American universities and technological institutes than in previous years.

Planned Expansion to Include More Navy Labs

In 1984 it is planned to increase the number participating Navy labs to include the Navy Aerospace Medical Research Institute in Pensacola, Florida and the Naval Ocean Research and Development Activity in Bay St. Louis, Mississippi, thereby bringing the total number of participating Navy labs to 12.

Plans for Continued Tracking of Research Fallout

As already noted, future occurring "research fallout" of Navy interest arising from later activities of former 1979, 1980, 1981 and 1982 NSFRP participants will continue to be tracked and will be reported in the 1983 Annual Report on a cumulative basis as herein and this procedure will be followed in all subsequent Annual Reports on NSFRP programs.

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